INSTRUMENTS and AUTOMATION

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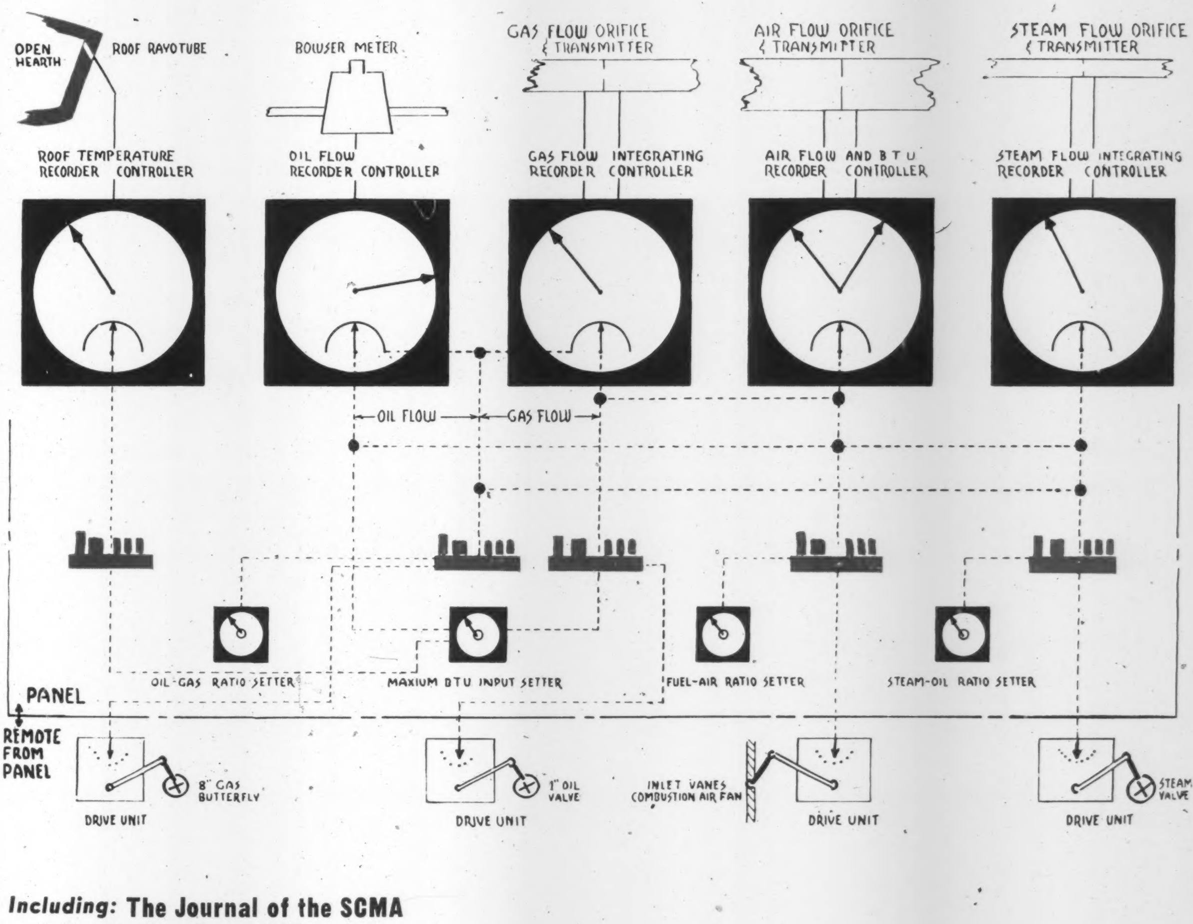
ELECTRIC CONTROL OF OPEN HEARTHS

. . . page 86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***Including:* The Journal of the SCMA *and* Simulation Council Newsletter**

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Vol. 29, No. 1
JANUARY 1956

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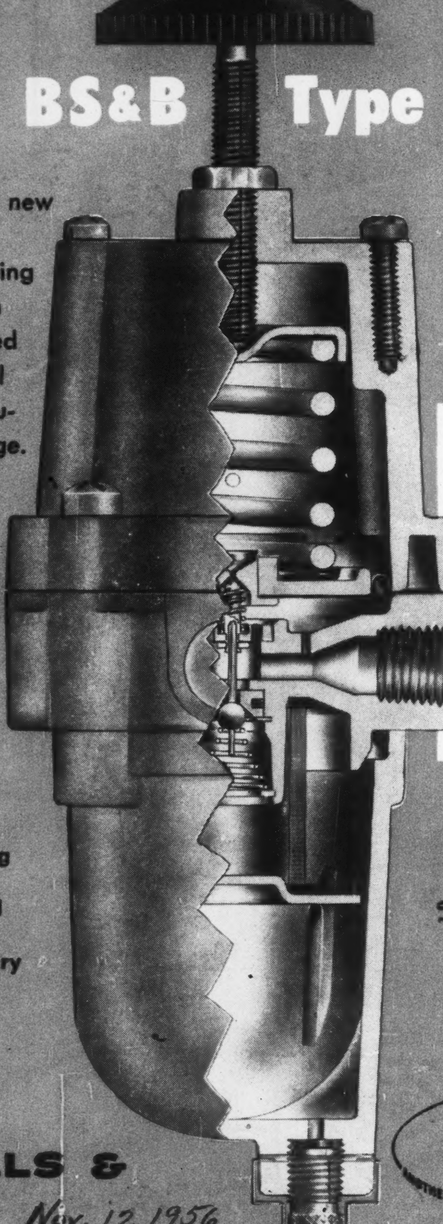

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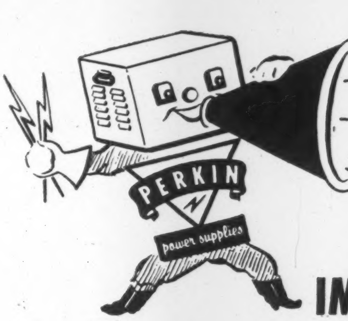

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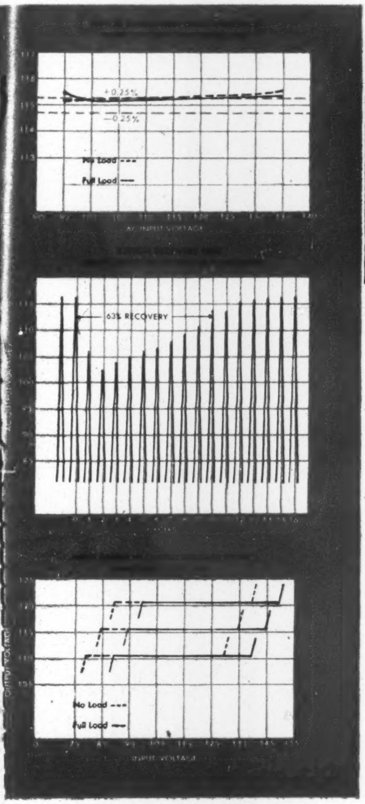

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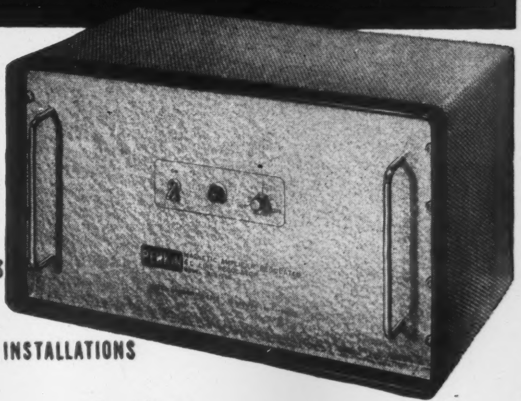

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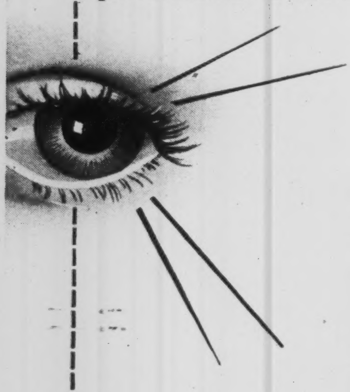

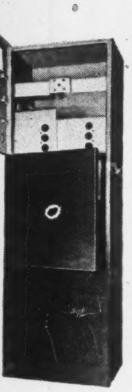

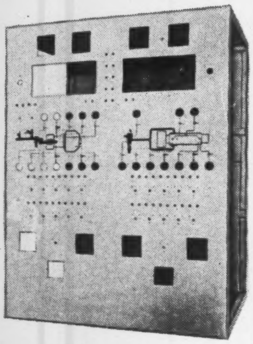

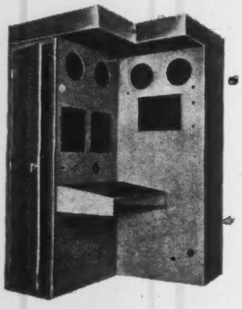

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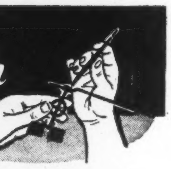

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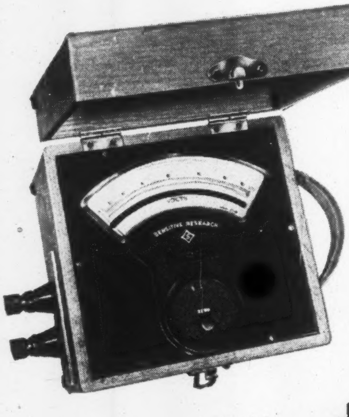

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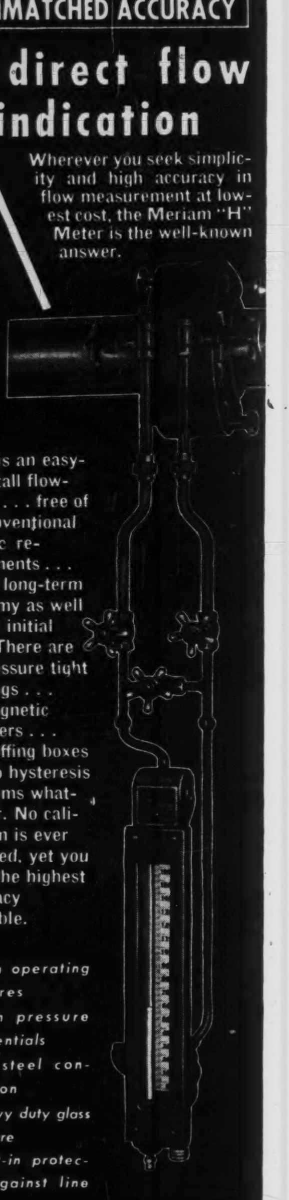

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INSTRUMENTS and AUTOMATION

Letters to the editor

Editor, I&A:

I am Assistant Professor of Structures at this Aeronautical Engineering Establishment of the Brazilian Air Ministry. I started teaching this year a course in Experimental Stress Analysis. One of the problems of the course was how to give the students —future Brazilian engineers—information on circuit constants and availability of commercial instruments and components adaptable to this field, which as yet is not covered adequately by technical publications and trade literature in Brazil.

Over the skepticism of some of my colleagues, I wrote letters explaining our situation to some 44 firms in the Instrumentation and associated fields, requesting descriptive literature in quantity (to be specific, 50 copies of each), to be included in the mimeographed textbook of the course.

To date, 31 of these firms have complied with request, which I know entailed very appreciable mailing and handling costs, and the advertising value of which could certainly be considered only secondary.

I believe this action is indicative of a progressive attitude in the Instrumentation Industry taken as a whole, and deserves commendation. In addition, both our establishment and our students are personally grateful for the assistance given to our educational program. Not being in a position at present to return adequately the favor done for us or to thank personally the cooperating companies, I should like very much to express our gratitude publicly and acquaint our colleagues in the Instrumentation Field in the States with the good will exhibited by the Industry in general, and the following companies in particular:

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Hanns J. Maier
Ministerio da Aeronautica
Instituto Tecnologica de Aeronautica
Brazil

This letter has several important implications. It reaffirms the progressive, dynamic character of the instrument manufacturer of the United States of America, whose devotion to Instrumentation transcends immediate monetary considerations. It also shows that Professor Maier has discovered a source of excellent educational material—the brochures published by the instrument manufacturers. And it shows that our policy of reporting *all* this literature to the field of instrumentation is important. We are pleased to publish this acknowledgement of a contribution made by these companies to our South American neighbors.

Editor, I&A:

As a new reader, whose field is the generalized theory of communication and control, I find *Instruments & Automation* enormously stimulating. Each new issue is educational, but none is disproportionately devoted to a narrow specialty. Readers with a vital concern for such specialties, however, are not neglected. Articles addressed to them are written (or edited) to provide sufficient frames of reference overlapping with those of readers like myself.

Putting it another way: we of general interests are fully informed of the diversity of applications while a specialist is either guided to sources or provided with supplemental material which can satisfy him.

All your contributors write good simple straightline English, without filler. Your illustrations and captions augment rather than repeat the text. In many ways I am reminded of the work of the late Kendall Banning. Like Banning, you appear to have grasped the principles of Korzybski's general semantics without finding it necessary to overtly remind the reader.

Material in the *Journal of the SCMA* and in the *Simulation Council Newsletter* generally has maintained the same high standards set in the magazine proper. Are there other such available? If so, try to bring them into the fold.

Harrison Gilmer
909 Keystone Bldg.
Pittsburgh 22, Pa.

We would be less than human were we less than delighted with such expressions of appreciation. This type of positive feedback is truly regenerative—driving us immediately to full speed ahead on all fronts. (P.S.—"good, simple English, without filler" is the result of good contributors *plus* good editors.)

Editor, I&A:

Enclosed is a list of 25 names and addresses for one-year subscriptions to *Instruments and Automation* plus remittance for same.

All of the subscribers work at the Firestone Tire & Rubber Co., Guided Missile Division. Please send their subscriptions to their home address.

Russell G. Smith
Long Beach, Calif.

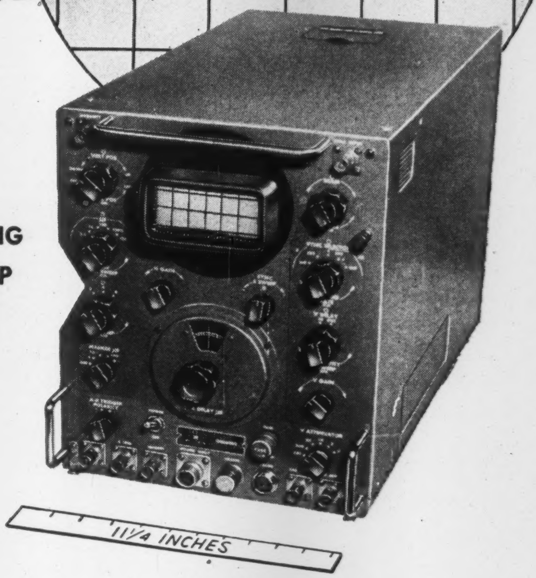
P.S. It wasn't very hard to sell 25 subscriptions because to me it is the finest magazine published in the instrument field.

This is why I&A needs no subscription salesmen. Our readers work for us—and we enjoy our work for you.

Editor, I&A:

The article "Digital Automation," by Klein, Williams, and Morgan, in your October issue, has been read with interest. A series of tutorial articles on this subject will be welcome.

However, we feel that there is exhibited a regrettable tendency to confuse "digital" and "discrete"; a confusion which we are sure does not exist in the minds of the authors, but



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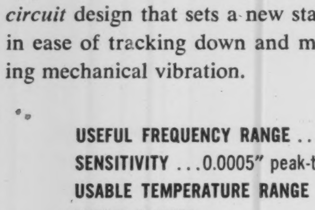

For more complex vibration studies (where power is available) use CEC's Type 1-117 Vibration Meter. It has 4 input channels, interchangeable high-pass filters, and indicates velocity as well as displacement. (Bulletin CEC-1538A-X6.)

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LETTERS—CONTINUED

which may be created in the minds of the less experienced readers whom they are seeking to reach.

The feature of being discrete, or sampled, is not sufficient to place data in the digital category; we are all familiar with analog systems which use discrete samples of data. The essential feature of a digital system is that the smallest change which can be recognized in the data is non-zero, and is a constant of the system, independent of the magnitude of the data. All changes of data must be integral multiples of this least change. This is "quantization," not sampling.

An example of the confusion is given by Figure 1-2 of the article. Here the independent variable, time, has been quantized, and can be represented digitally. But the data, the value of the independent variable, has not been quantized, merely sampled. At any selected sampling instant the value of the sample is the instantaneous value of the curve, and the change from sample to sample may be arbitrarily small. This is still an analog representation. To be represented digitally, the amplitude scale must be divided into a set of uniform intervals, and the index value of the integral within which the curve lies at the sampling time taken as the value of the data.

To summarize, the phrase "discrete or digital" is misleading in its implication that the two words are synonomous. They are not.

A. C. Byers
Chief, Electronics Section
The Franklin Institute
of the State of Pennsylvania
Philadelphia 3, Pennsylvania

This distinction between "discrete" and "digital" is important—and little appreciated, as the author points out below:

Editor, I&A:

Mr. Byers' comments are true and his terminology is certainly one which should be adopted as a more or less precise standard. There previously has been, to our knowledge, no clear statement of the differences—and this regrettably includes our own efforts in the first article. (The examples used were pedagogically devised to impress certain points. As Mr. Byers points out, this can easily lead to confusion.)

It is the writer's suggestion that Mr. Byers' remarks be carefully considered and the differences between digital and discrete, and between quantization and sampling be remembered.

We are grateful for having this called to our attention.

Dr. Martin L. Klein

---

ditor, I&A:

I can't help but comment on your ditorial "Automation and Culture" n *Instruments and Automation*, Auust 1955 . . . You have carefully eminded us that the success or failre of a society depends not on its aterial progress or lack of progress ut on the moral and spiritual caliber f its members.

esearch Engineer
linneapolis-Honeywell Regulator Co.

The author of this comment wants is name withheld. It should be rinted in all caps, bold face type.

---

ditor, I&A:

I want to commend you on a very fine magazine featuring down-to-earth, practical subjects that are so vitally needed in this age of automation.

G. A. Pettit
Application Engineering
Barber-Colman Company

We love you.

Editor, I&A:

One of the biggest reasons you will lose subscriptions is that you lose sight of the fact that there are quite a few people who have no idea what the articles are about. In other words it is over their heads!

Remember, there are a lot of instrument men without degrees who are interested in the practical aspects of instrumentation and the more elementary theory.

John Kolesnik
Philadelphia, Pa.

There had to be another side to the story!—And here we were, thinking ours was the "practical" book in the field. We'll try even harder in the future to bring out the innate simplicity of things technical.

Editor, I&A:

I read you magazine almost every month . . . it seems to get better every month.

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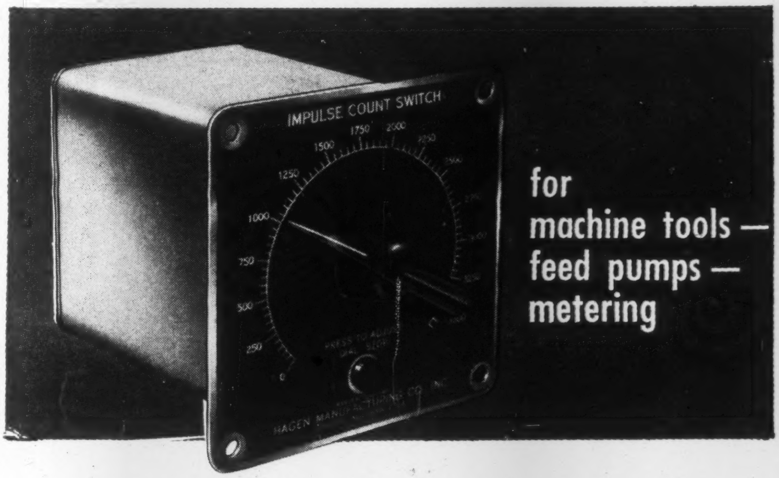

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Simply set this Hagen Count Switch to the number of operations at which a tool should be changed. The count switch trips a switch after a preset number of electrical impulses . . . and thereby shuts down the machine automatically. Tool wear never reaches the point where tools must be ground down excessively to resharpen. That means increased tool life, reduced tooling costs and fewer rejects. Compare the savings on just *one* tool with the cost of this reasonably priced Hagen Count Switch. Chances are, the savings will be much greater.

This Hagen Model 70 Count Switch has 72 dial divisions . . . 72 possible settings. Dials are available with up to 54,000 counts. Accuracy: 1% of full scale range. Ideal for feed pumps and metering operations. Send coupon for Bulletin 780 — or data on the complete line of reset and repeating cycle timers and counters, interrupters and control assemblies.

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Moline, Illinois Yorktown, Wisconsin
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☐ Please send free Bulletin 780 on Hagen Count Switch.
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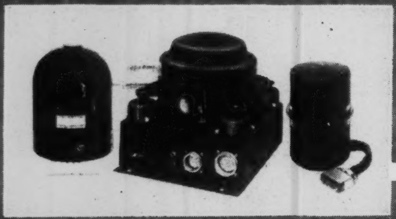
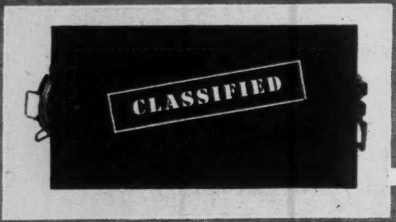


Kearfott gyros, used for stabilization or guidance in the majority of aircraft and missiles in production today. Vertical, directional and rate-integrating gyros shown.

Link Aviation F-89D; jet flight simulator duplicating exactly cockpit of the F-89D interceptor; Link simulators for more advanced planes may not be shown.



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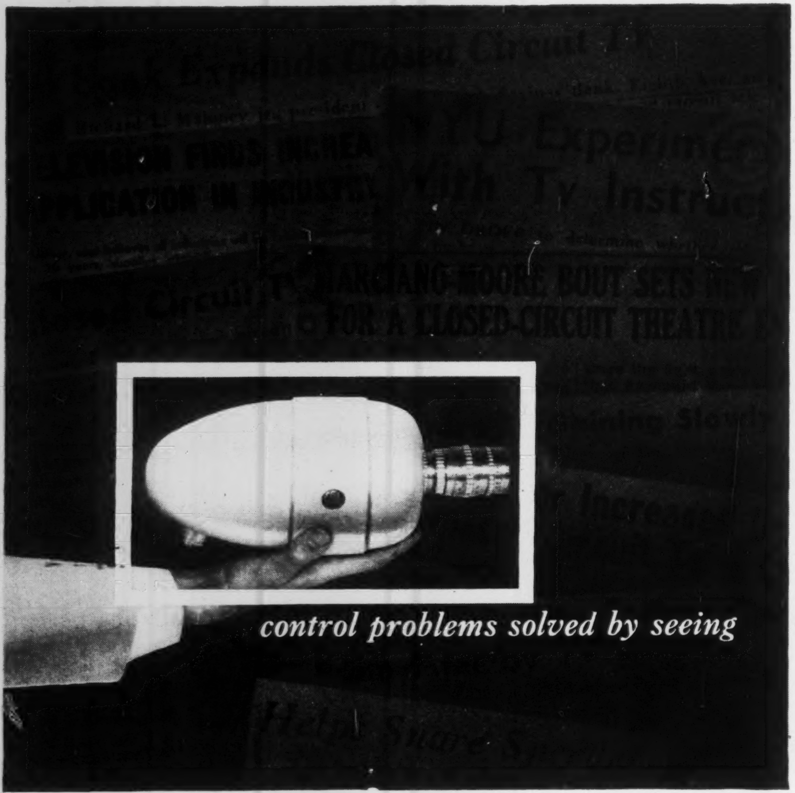
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THE NEW LIGHTWEIGHT U.S.A.F. J4 COMPASS SYSTEM PERMITS PRECISE FIGHTER NAVIGATION AT ALL LATITUDES

ANOTHER MAJOR GYRO PROBLEM SOLVED BY WEAPONS GUIDANCE LAB. U.S.A.F. AND KEARFOTT

This miniature Kearfott Directional Gyro is the heart of the U.S.A.F. J4 Compass System. The System provides both latitude corrected and magnetic slaved directional gyro heading information. Suitable output transmitters are incorporated to supply compass data to autopilots, course indicators, and other systems requiring this information. This system provides all the functions of the Kearfott designed U.S.A.F. N1 Compass System with little loss in accuracy despite a 66% reduction in weight. The J4 Compass System as designed by Kearfott was selected by the Air Force ". . . due to its adaptability to product improvement and Kearfott's ability to meet the urgent requirements of the Air Force."

U.S.A.F. J4 Directional Gyro
Random drift rate 3° per hour max.
Weight 7½ lbs.

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VERTICAL GYROS: Precise verticals with 2 mins. vertical accuracy (Bench) weigh 7 pounds and measure 5⅛" diam. x 6⅝" high. Miniature verticals with 15 mins. vertical accuracy weigh 3.5 pounds and measure 3" x 3" x 4" approx.

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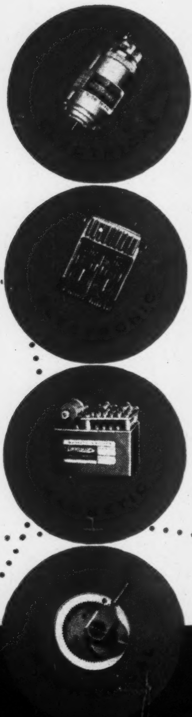

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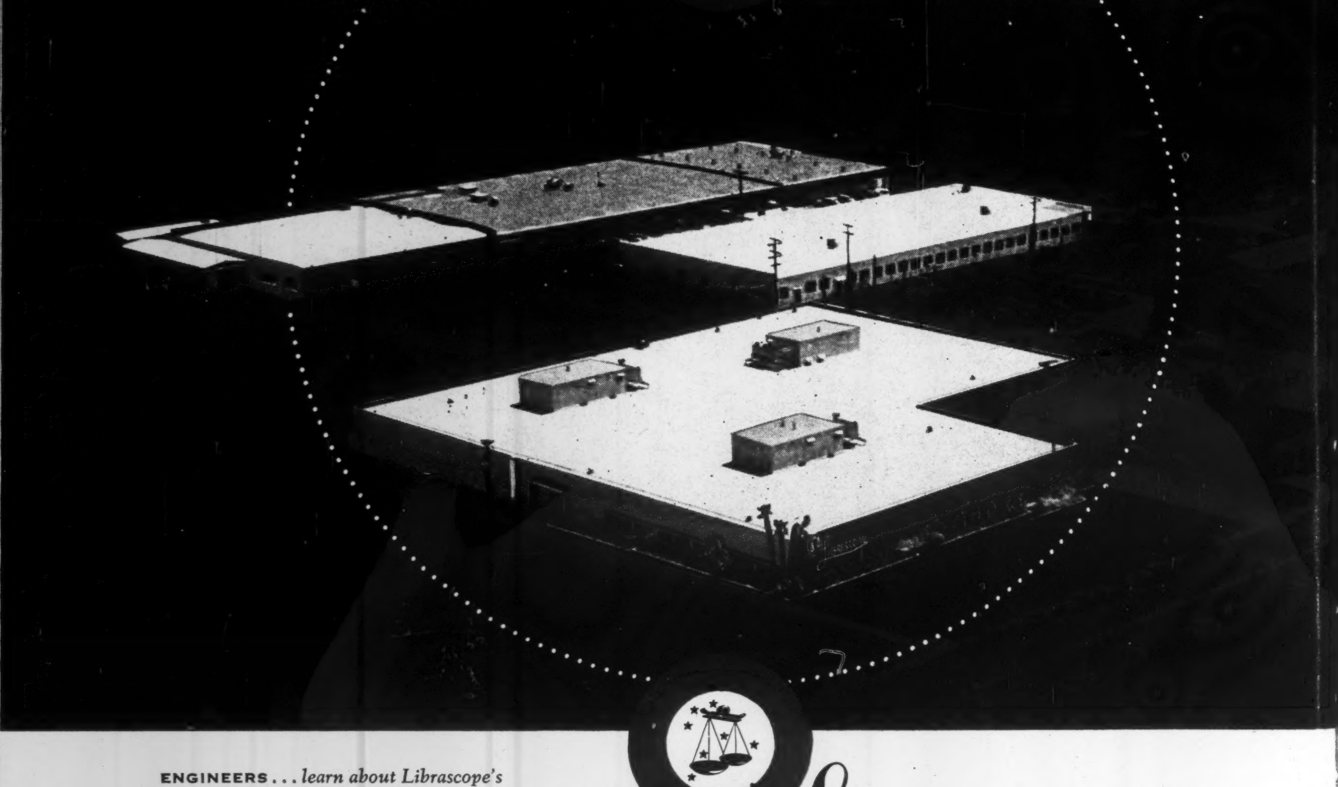

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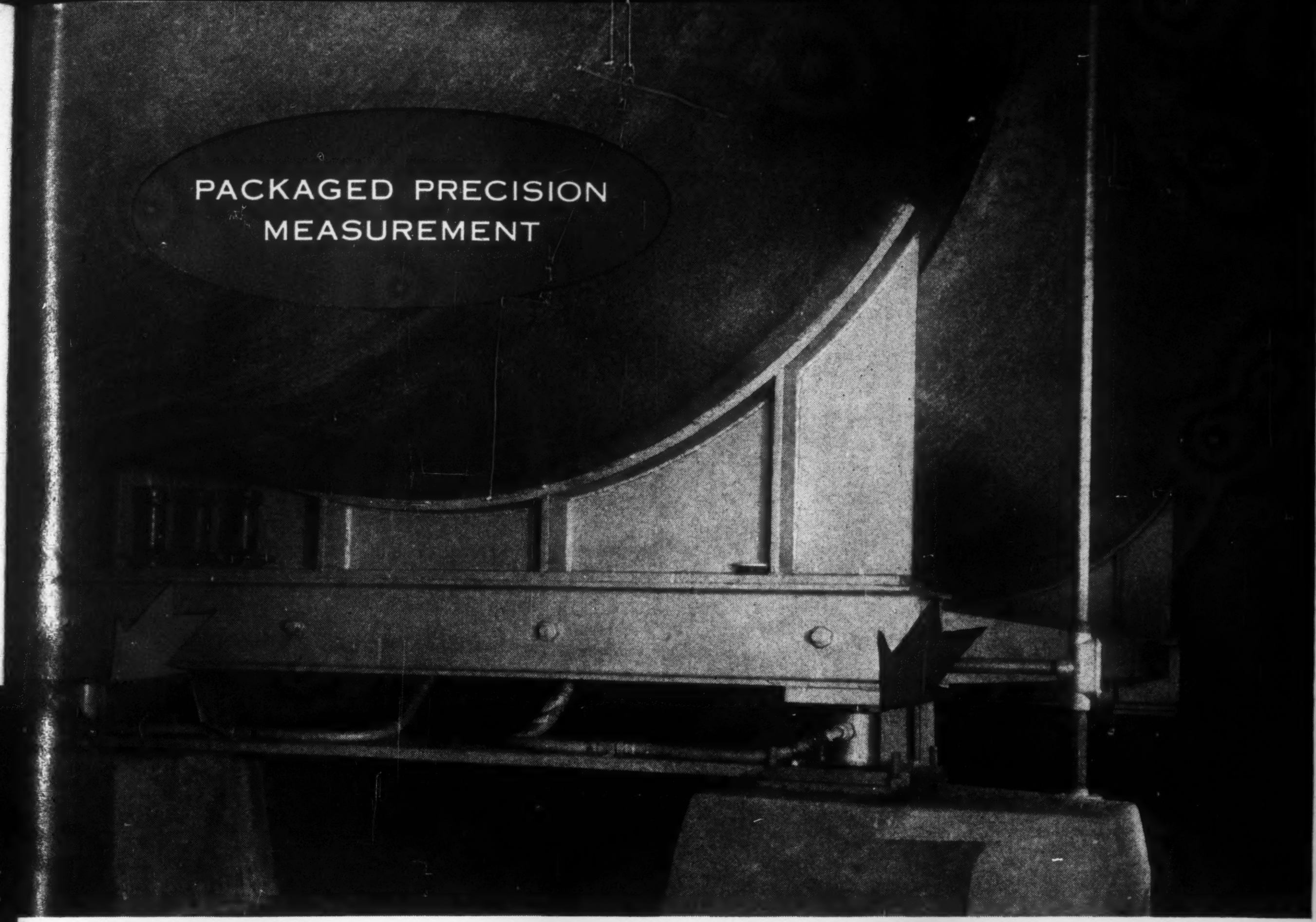


Stanley Home Products, Inc. checks Freon losses as

Two tiny SR-4® Load Cells weigh 200,000 lb. tanks automatically

Baldwin's "Packaged Precision Measurement," neatly solved the handling of large volumes of Freon at the Stanley Home Products plant in Easthampton, Mass. A constant record of stored and used quantities was needed to avoid excessive leakage and evaporation losses.

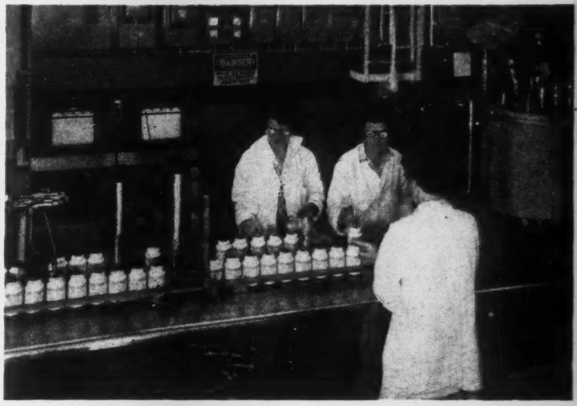
Continuous automatic weighing of their two 15,000 gallon storage tanks with Baldwin SR-4 Load Cells answered Stanley's problem perfectly. Two small SR-4 compression-type 50,000 lb. load cells were installed as supporting members on the concrete base at one end of each tank. These support exactly half the load of the 200,000 lb. tanks and the instruments are calibrated to read only the weight of the Freon in the storage tanks.

Reinforced flexible hose at inlet and outlet eliminates effect of connecting piping on weighing accuracy.

This Baldwin system gives Stanley weighing accuracy within ½ of 1% of scale (200,000 lbs.). Baldwin-engineered instrumentation provides remote indicators at the tank car siding and recorders at a centralized control panel. The weighing system controls a motor-driven pump at the siding, shutting it down automatically when the tanks have 13,500 gallons of Freon.

Packaged Precision Measurement can solve similar problems for *you.* For detailed information on SR-4 Device applications and instrumentation use coupon today.

Baldwin strip chart recorders on wall (lower photo) show rate of consumption of Freon. Recorders are connected by electrical cables to SR-4 Load Cells under one end of 15,000 gallon tanks on other side of wall (upper photo).



Dept. 3315
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Philadelphia 42, Pa.
(In Canada: Peacock Bros., Ltd., Montreal, Quebec)

Please send me the following new literature

☐ Bulletin 4300 (Introduction to SR-4 Devices)
☐ Bulletin 4301 (SR-4 Load Cells and Load Beams)
☐ Bulletin 4302 (SR-4 weighing of tanks, bins, hoppers)
☐ Bulletin 4306 (SR-4 Fluid Pressure Cells)

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BALDWIN-LIMA-HAMILTON

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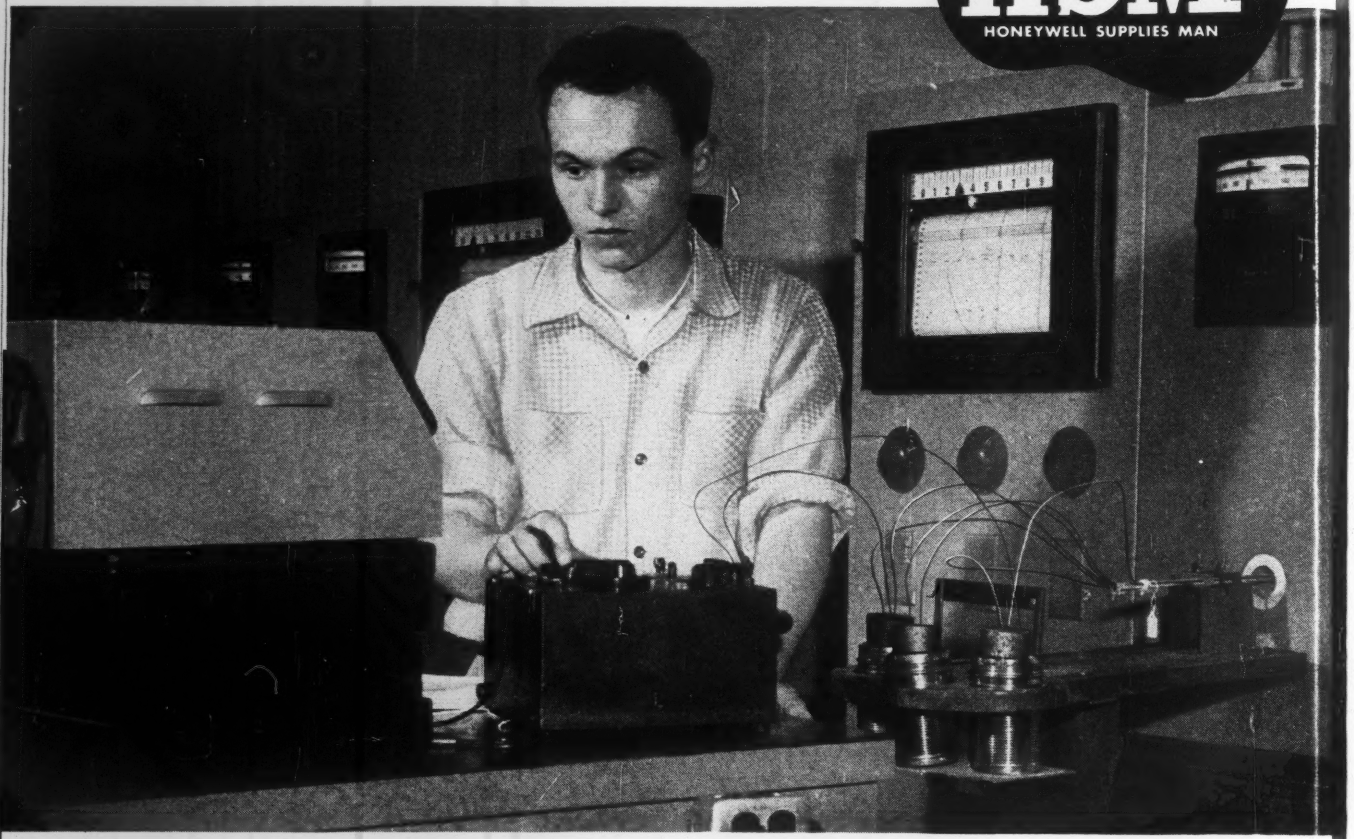
Lab-tested thermocouple wire *available through your*

HSM

HONEYWELL SUPPLIES MAN



CONNECT a thermocouple with only ± 1% accuracy to an instrument with accuracy of ± ¼% . . . and how closely can you measure? The answer is simple. Overall accuracy *can't* be any better than your thermocouple.

To guarantee you consistent accuracy in your temperature detecting elements, Honeywell maintains a fully equipped wire checking laboratory. Here every spool of thermocouple or extension wire is tested against standard wires that have been certified by the National Bureau of Standards. Checks are made at numerous points throughout the temperature range of the calibration in which the wire will be used. Every spool of wire meets rigid standards before it is accepted. Calibration figures are tagged on each spool.

The result of this laboratory control is that every order of Brown thermocouple or extension wire you receive can be counted on to deliver identical standards of high precision.

Ask your Honeywell Supplies Man to give you complete facts about Brown thermocouple and extension wires . . . and to tell you how the HSM Plan can bring you new convenience and economy in all your purchasing of pyrometer supplies. Call him today at your local Honeywell office . . . as near to you as your phone.

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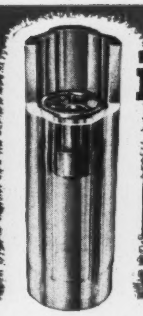
What *Type Flowmeter* is *Right* for You?

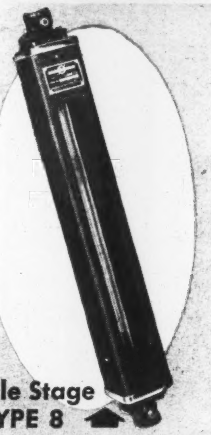
COX

TYPE 8
TYPE 10
TYPE 12
TYPE 14



FLOWMETERS

All have *"Inner Wall Guide"* Design for Perfect Match of Tube and Float



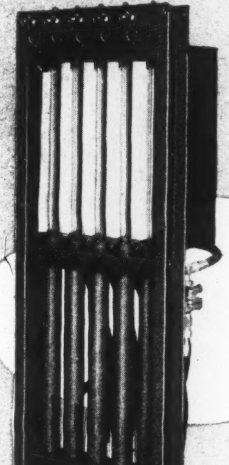
Single Stage
TYPE 8

Ideal for measuring rate of flow in production line processes where accuracy and performance must be matched by low cost operation.

If, like many of our customers, you depend upon flowmeters primarily for production, the Single Stage **Cox Type 8** provides the right combination of accuracy, readability, and quick response so essential for low cost performance of this type. Lightweight, dependable, and easily operated, the variable area Type 8 is ideal for a wide range of production processes.

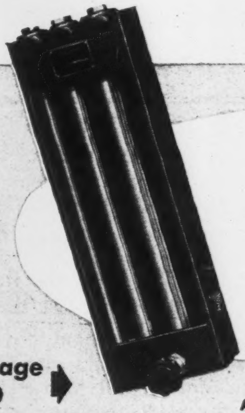
Should you require a research-type flowmeter capable of indicating very low flows in engines, pumps, carburetors, etc., the Multiple Stage **Type 10** is the answer. Used extensively in automotive engine laboratories, it is accurate within ± 1% of the reading at any point on the scale.

Where high capacity, high accuracy is essential, Cox Multiple Stage **Type 12 Flowmeters** — 40, 90, and 100 Series — and the high pressure **Type 14** are unsurpassed. Logarithmic scales provide the same degree of readability (from ¼% to 1% depending upon the Series) at *all* points throughout the flow range. Capacities up to 130000 PPH are available, where needed. And like all Cox Flowmeters, the Type 12 and Type 14 feature "Inner Wall" guides, integral with the tapered tube, which accurately match contours of the float, and assure stability and repeatability of float position. Explosion-Proof backlighting with translucent scales for maximum visibility available on the Type 12 and Type 14.



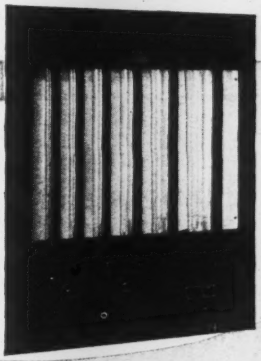
Multiple Stage
TYPE 14

A high pressure Multiple Stage flowmeter for pressures up to 1000 p.s.i. Uses the same logarithmic scales as the Type 12 and provides unsurpassed readability. Capacities to 36000 PPH.



Multiple Stage
TYPE 10

Combination laboratory-industrial flowmeter. Developed to handle low flow rates and varying temperatures and viscosity encountered in engine, carburetor and pump testing.



40
Series

Multiple Stage—TYPE 12

Available with bypass orifice which greatly raises maximum range (up to 90000 PPH) without increasing number of tubes. Like all Cox Flowmeters, the Type 12 is calibrated on Cox Calibrating Stands—accepted primary standard of calibration throughout the automotive and aircraft industries.

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For more information circle **15** on inquiry card.

LEWIS PORTABLE PYROMETER POTENTIOMETERS

FOR MEASURING TEMPERATURES ELECTRICALLY

- IN MOVING VEHICLES
- IN AIRCRAFT
- IN THE LABORATORY

ACCURATE, DIRECT-READING, EASILY-OPERATED INSTRUMENTS, WITH ELECTRICAL COLD-JUNCTION COMPENSATION.

These potentiometers have been used for years by the leading motor car and aircraft manufacturers for proving-ground and flight-test work as well as in the laboratory.

- Three models from which to choose the instrument for your application.
  - Model 13PO2, with single temperature scale.
  - Model 14PO (illustrated) with high and low temperature scales.
  - Model 78PO with one temperature and one millivolt scale or two temperature scales, for different thermocouple materials.
- Housed in a sturdy hardwood case, approximately 11⅜" long, 10" wide and 7⅞" high. Weight approximately 17 lbs., shipping weight 20 lbs.
- For dependable temperature instrumentation, use these potentiometers with LEWIS leads, selector switches and thermocouples.

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Manufacturers of Complete Temperature Measuring Systems for Aircraft

For more information circle **16** on inquiry card.

INSTRUMENTS and AUTOMATION Trends

Industrial electronics, now consuming about $600 million annually, is expected to exceed $1 billion annually by 1960.

Military spends about $2.5 billion annually on electronic equipment. Total is expected to exceed $3 billion by 1960; $4 billion by 1965.

Electronics Production Resources Agency reports that there were 3600 manufacturers of electronic equipment and components at beginning of 1955, a fivefold increase since 1939.

Trends in farming: Census figures show that between 1920 and 1950, number of farms containing from 10 to 260 acres decreased from 5.5 million to 4.1 million; total number of farms of all sizes decreased from 6.4 to 5.4 million; acreage held by farms of 1000 acres or more (2.3% of all farms) increased from 221 million to 495 million (45% of 1950 total farm acreage). Increasing number of large farms, with increasing average size, should expand markets for more automation equipments.

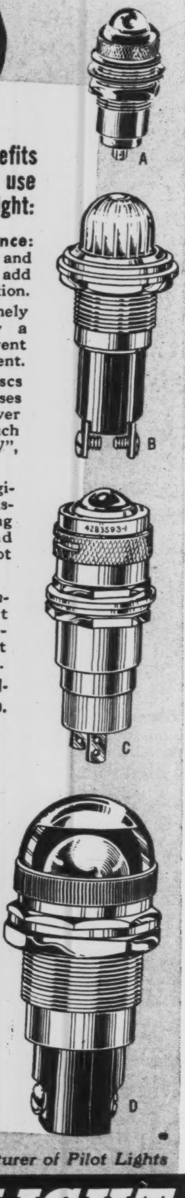
Pharmaceutical research has expanded 10 times between 1941 and 1953, attaining a volume of $180 million in 1953. Result: three-time expansion in number of drugs to combat disease and increase life expectancy. New drugs include those in hormone field (such as cortisone), new vitamins and amino acids, antibiotics, vaccines, etc. Sales of pharmaceuticals have expanded from $300 million in 1939 to an estimated $1560 million in 1954, says A. D. Little Industrial Bulletin.

Average number of shares listed on New York Stock exchange has increased from 1.54 billion in 1945 to more than 3.2 billion in 1955. Daily volume of about 3 million shares in 1955 (which is far less than in previous years) requires automatic display boards. Teleregister boards alone now serve nearly 400 offices.

At least 12 companies now offer machine tools with electronic controllers.

Elgin National Watch surveyed relay market before acquiring two relay firms—and found that although miniature relay market is now divided 85-10-5 percent between military-industrial-commercial, trend to automatic control should cause ratio to become 50-35-15 in five to ten years.

Fully-instrumented satellites for projection into stratosphere are now being developed. First use: to aid astronomers, physicists and broadcasters. Possible use will be repeaters for TV and radio signals.



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DIALCO

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Greater safety: A timely warning flashed by a pilot light can prevent damage to equipment.

Added service: Discs inserted behind lenses can be used to deliver specific messages, such as "FUEL LOW", "ON", "OFF", etc.

Let the Dialco engineering department assist you in selecting the *right* lamp and the *most suitable* pilot light for your needs.

Dialco offers the *complete* line of pilot lights, from sub-miniature types to giant units with 1½" lenses.

Every assembly is available complete with lamp.

SAMPLES ON REQUEST AT ONCE — NO CHARGE

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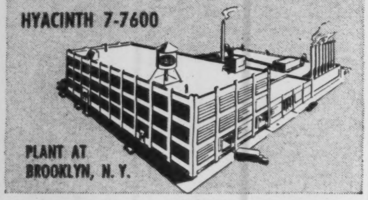


For more information circle **17** on inquiry card.

INSTRUMENTS and AUTOMATION Inquiries

The inquiries below were received from subscribers to **Instruments and Automation.** In most instances an answer has been sent, but we shall be glad to forward the name and address of the inquirer if you have any further suggestions.

Traveling Recording Thermometers

Brewing company seeks manufacturers of "traveling recording thermometers" that are used to record fluid temperature while traveling through pasteurizer; time element as well as temperature range." A-1

pH Control

Agriculture-station expert seeks pH instrument that will open and close valve in range of pH 4.6 to 4.7, also one with sensitivity of 0.1 with control. A-2

Smoke Density Gage

Air conditioner manufacturer seeks "visual smoke density gages." A-3

Ocean Clam Processing

Consultant seeks information on process of "dragging, unloading, shucking, cleaning, eviscerating, grinding, weighing, packing, transporting, freezing and storing of ocean clams." A-4

Citrus Selectors

European office of large instrument manufacturer seeks manufacturers of photocell actuated equipment for sorting citrus fruits for size, color, etc. A-5

Machine Timer

Coupling manufacturer seeks instrument for recording tool cutting time only; not over-all "On Time" of machine. A-6

Wire Diameter Gage

Reader seeks device to continuously check wire diameter (approx. 3 mils). A-7

Flow Nozzles

Reader seeks ASME or ASRE standard flow nozzles for air measurement . . . . not to be confused with indicating devices built with such nozzles, but rather the sheet metal nozzles themselves. A-8

Testing Device

Reader seeks device for testing electrical components of portable electrical tools . . . . a box containing several plug receptacles, pilot lights, switches, etc. for indicating the integrity of the cord, ground wire, etc. A-9

Rotary Limit Switch

Manufacturer seeks rotary limit switch which, attached to a shaft, will maintain open contact at rotary speeds of one tenth r.p.m. and will close if the shaft stops, without reversal of the shaft. A-10

Blood Counting

Reader seeks electronic instrument for automatic blood counts. Device employs a cathode ray screen marked in grid pattern; beam moves across face of tube counting particles in field of view. A-11

Demineralizer

Chemist seeks lab size demineralizer. A-12

Photographic Recording Techniques

Aeronautical research lab seeks means of recording which gives an immediately visible photographic-type record. A-13

Speed Measuring

Research lab seeks speed measuring device for measuring speed of truck (½ to 5 mph) which can be adapted to produce a proportional pneumatic output signal, or an electrical or hydraulic output signal for control purposes. A-14

Magnetic Materials

Foreign reader seeks information on magnetic materials used in development of radial-vane repulsion mechanism in moving iron instruments, and the suppliers of the materials. A-15

Compressive-load Pickup

Reader seeks commercially produced pickup for compressive load (0-50 lb min. or 0-125 lb max.). A-16

Low-Torque Pot

Large industrial instrument manufacturer seeks source for low-torque potentiometers (below 0.1 oz in) with resistance values to 1.5 megohms. Precision not essential. A-17

Pressure System for Chemical Injection

Reader seeks "pressure system for use in wood preservative injection into wood where termites and powder post beetles are found . . . system must not corrode from liquids, such as chlordane mixtures." A-18

Electrically Operated Valve System

Reader seeks system for electrically opening and closing gate valves with adjustable torque. Also seeks torque measuring devices with specially wound inductor that is placed near rotating shaft to measure torque; a similar device to measure rpm; and high-speed recording oscillograph that has no pen but which sprays ink on moving chart. A-19

bdl Amplitude Measuring

Research engineer seeks information to aid in problem of measuring bdl amplitudes down to 20 microinches from 5 to 2000 cps. Also information on how to do it electronically. A-20

Shredding Device

Chemist seeks device used to obtain fine cut filings of 250 mesh of dental alloys (silver, tin, copper and zinc). A-21

Differential-Pressure Level-Measuring Device

Foreign reader seeks device for measurement of level in a sphere used for storage of liquid ammonia . . . . a differential-pressure level-measuring device . . . . and a device for volumetric measurement. A-22

Clothing Pressure Measurement

Reader seeks information on device for measurement of pressure exerted on the human body by tight clothing. A-23

Coke Bed Control in Cupola Operation

Foreign reader seeks an electric or electro-magnetic device which allows exterior determination of the height of a coke bed in the interior of a cupola while in operation. A-24

High-Voltage Transformers

Professor seeks design information on high-voltage transformers in the 50 to 100 KV range; and a high-voltage bushing suitable for transformers in this range. A-25

Thin-film Applicator

Manufacturer seeks device for laying down a wet film of definite thickness (0.0015 in.) of paint or other coating on a glass plate. A-26

Beryllium-Copper Strip

Foreign reader seeks source of beryllium-copper strip. A-27

Constant-pressure Cylinder

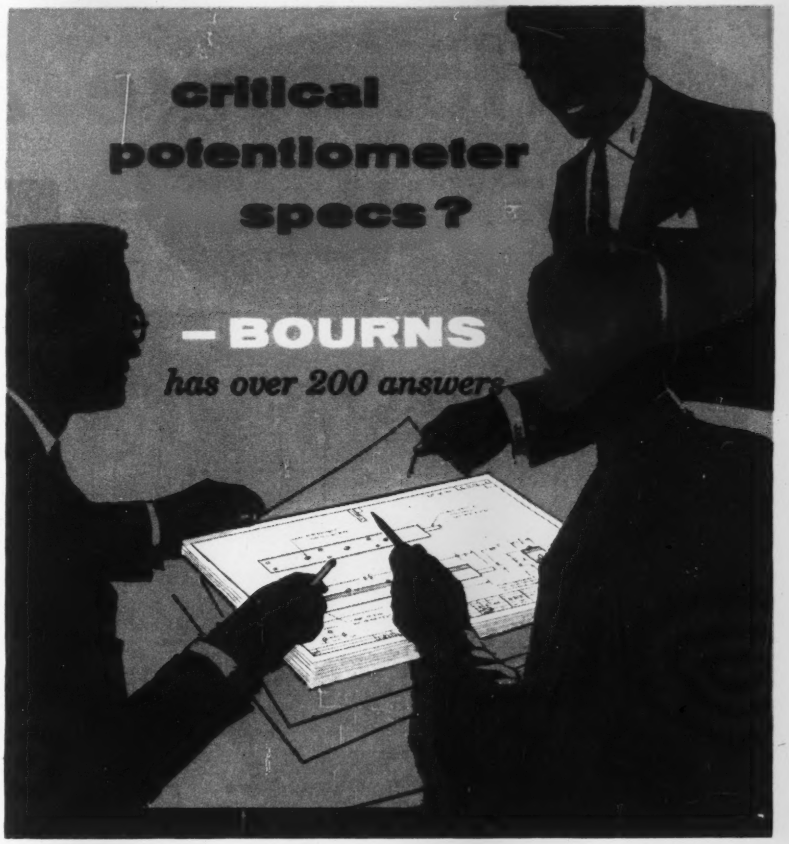
Manufacturer seeks air or hydraulic cylinder which exerts constant pressure (0 to 10 lb.) at any position of stroke. Pressure to be adjustable. A-28

Pressure Gage

Reader seeks "a 2½ in. to 3 in. dial 100# stainless steel pressure gage." A-29

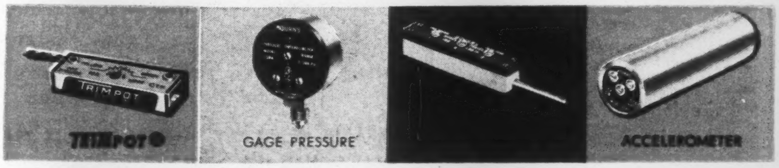
Audiometer

Reader seeks source of audiometers. A-30



To fit numerous applications, Bourns has 200 designs of miniaturized, high-performance sensing instruments on file. These designs are either standard types, or variations made to meet critical electrical and environmental specifications. The pressure potentiometer designs range from ½ to 10,000 p.s.i. Linear motion units provide travels of ⅛" to 30", and you can choose from a wide variety of resistance ranges.

The instrument you need may be among these Bourns designs—ready for production from parts in stock. Or one of the designs now on our boards may meet your specs. If not, we will gladly consider developing the instrument you require. Send us your specifications—your problem may already be solved.

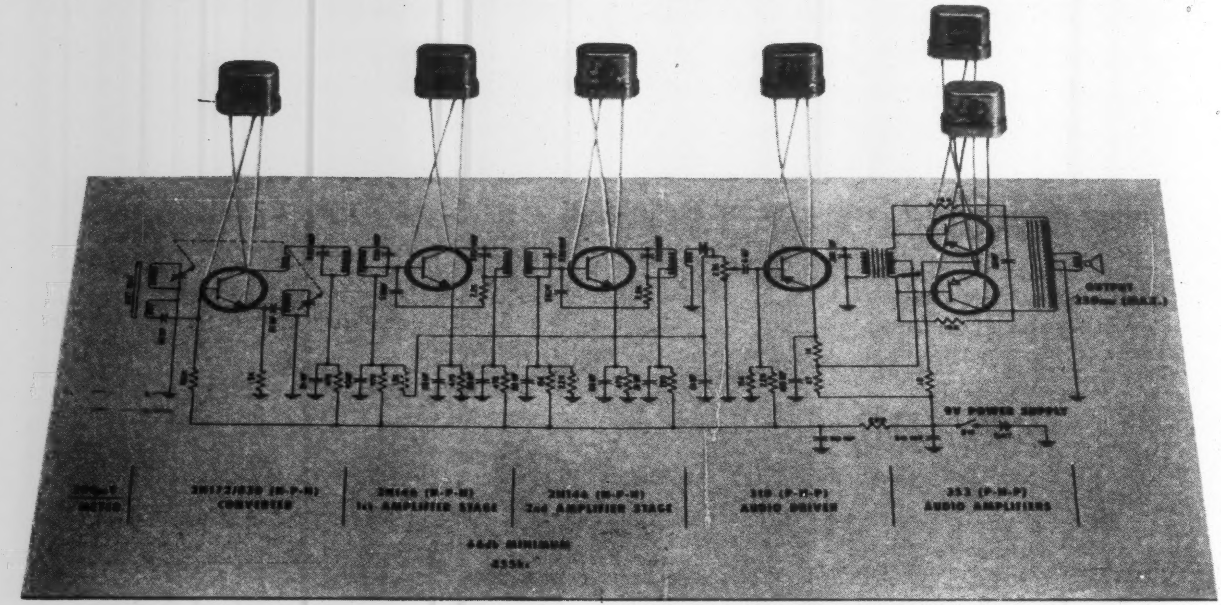


BOURNS LABORATORIES
6135 Magnolia Avenue, Riverside, California
Technical Bulletins on Request, Dept. 22

For more information circle 18 on inquiry card.

TI PROGRESS REPORT ON RADIO TRANSISTORIZATION

Performance . . . not promises!


OUTPUT 250mw (MAX.)
9V POWER SUPPLY
2N172/830 (N-P-N) CONVERTER
2N146 (N-P-N) 1st AMPLIFIER STAGE
2N146 (N-P-N) 2nd AMPLIFIER STAGE
310 (P-N-P) AUDIO DRIVER
353 (P-N-P) AUDIO AMPLIFIERS
44db MINIMUM
455kc

Texas Instruments germanium transistors are used in 85% of the many brands of transistorized radios now being manufactured! Since TI transistors made possible the FIRST transistorized radios 15 months ago, improved mass production methods have rapidly increased performance and decreased prices.

In less than a year and a half, progress in TI transistors and radio circuits has been so swift that the following improvements are now production realities:

	1954	1955
Sensitivity	2000 μv/m	200 μv/m
Operating Voltage	22½V	6, 9, or 12V
IF Gain & Frequency	31db @ 262 kc	35db @ 455 kc
IF Output Capacity (C_{ob}) . . .	30-40 μμf	1 μμf
IF Neutralizing Capacity . . .	Selected	Fixed
Audio Output Power	20mw	250mw
Typical IF Transistor Price . . (In complete OEM kit)	$2.50	$1.75

IN THE CIRCUIT ILLUSTRATED ABOVE:

Left to right: a 2N172/830 germanium N-P-N graded junction converter, two 2N146 germanium N-P-N graded junction IF amplifiers, a 310 germanium P-N-P fused junction driver, and two 353 germanium P-N-P fused junction outputs. This is a typical TI circuit designed for optimum performance.

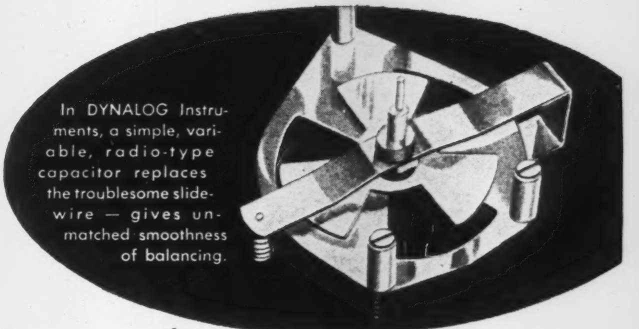
Your *own* transistorized product development will also benefit from Texas Instruments progress which gives you proven products, immediate availability in production quantities, and economical prices. *First* with transistors in commercial radios, *first* with high gain, low voltage IF transistors, *first* with high temperature silicon transistors . . . Texas Instruments consistently leads the industry in development and manufacture.

LOOK TO TI FOR: GERMANIUM RADIO AND GENERAL PURPOSE TRANSISTORS • SWITCHING TRANSISTORS • SILICON SMALL SIGNAL AND POWER TRANSISTORS • SILICON JUNCTION DIODES

Texas Instruments has produced more radio transistors than any other manufacturer!

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

For more information circle **19** on inquiry card.



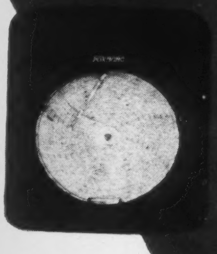
In DYNALOG Instruments, a simple, variable, radio-type capacitor replaces the troublesome slidewire — gives unmatched smoothness of balancing.

This potentiometer has no slidewire

STEPLESS CAPACITY-BALANCING ELIMINATES SLIDEWIRE MAINTENANCE

DYNALOG'S* EXCLUSIVE BALANCING ACTION

- no slidewire
- no batteries
- no standardizing
- no gears, cables, etc.
- no high-speed reversing motor



There's no need to put up with worn slidewires and sticking electrical contacts . . . no need to periodically clean and lubricate balancing motors. DYNALOG design eliminates all this! Its simple variable capacitor and positive magnetic drive provide *continuous, stepless* balancing . . . *never* require attention!

DYNALOG's friction-free action provides high speed of response without wear. (There are only five moving parts, including the recording pen!) Sensitivity, unlimited by turns of slidewire winding, is 1/100 of 1%. And accuracy is a sustained 1/4 of 1%.

DYNALOG Instruments are available for use with resistance, voltage, capacity, or inductive type primary elements to measure and/or control any process variable . . . with unmatched smoothness. Write for Bulletin 427. The Foxboro Company, 371 Norfolk Street, Foxboro, Mass., U.S.A.

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DYNALOG
ELECTRONIC INSTRUMENTS

For more information circle 20 on inquiry card.

Here's the Complete "Package"
for Counting Electrically...
156872
Veeder-Root Inc. Hartford, Conn.

Added Evidence that —

Everyone Can Count on
VEEDER-ROOT

This Veeder-Root Reset Magnetic Counter (AC or DC) is actuated through electromagnets. And it may be connected in series with any device having a contact arrangement . . . like the specially designed Veeder-Root Electrical Contactor at the left, which insures positive operation of the counter, either in oscillation or connected directly to a revolving shaft . . . with the counter placed at *any* distance from the machine or process on which the count is required.

This is another one of the hundreds of Veeder-Root Standard and Special Counting and Computing Devices developed for every conceivable counting duty, in every field from atomics to electronics.

What do *you* need to count? Just write:

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Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.
Montreal 2, Canada
Offices and Agents in Principal Cities
"The Name that Counts"

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Want to pack your product into less space?

ELGIN can miniaturize your assemblies

When conserving space is vital (as it is in timing and control devices, small actuators and other electro-mechanical devices), call on Elgin's broad experience and skills for help. Miniaturization of assemblies demands special abilities and facilities in order to save space while maintaining or improving performance. We can help you redesign your assemblies and provide the highly specialized skills and facilities for assembly on a low-cost, volume basis. Call or write for a consultation at your convenience.

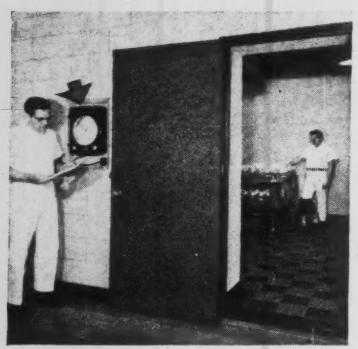
New Booklet Helps Solve Miniaturization Problems

Write today for "Practical Miniaturization"—free booklet explains miniaturization at Elgin and how it can help you.

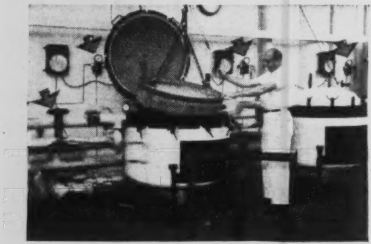
Practical Miniaturization

ELGIN NATIONAL WATCH COMPANY
ORDNANCE DIVISION • Elgin, Illinois

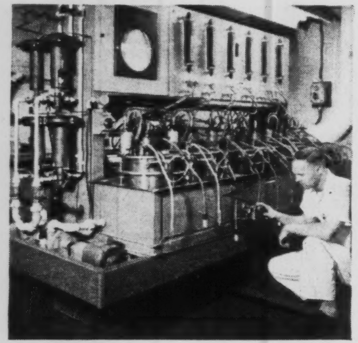
For more information circle **22** on inquiry card.



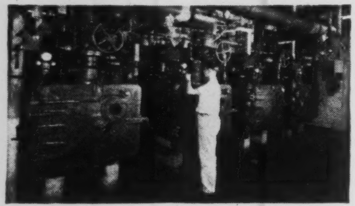
Shaker room and incubator in Fermentation Department. Powers Temperature Recording Controllers are used here.



Ampoule Sterilizers regulated by Powers No. 252 Pressure Regulators and Valves.

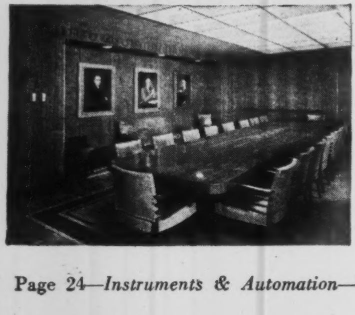


Fermentation process in research pilot plant controlled by Powers ACCRITEM Regulators and FLOWRITE Valves.



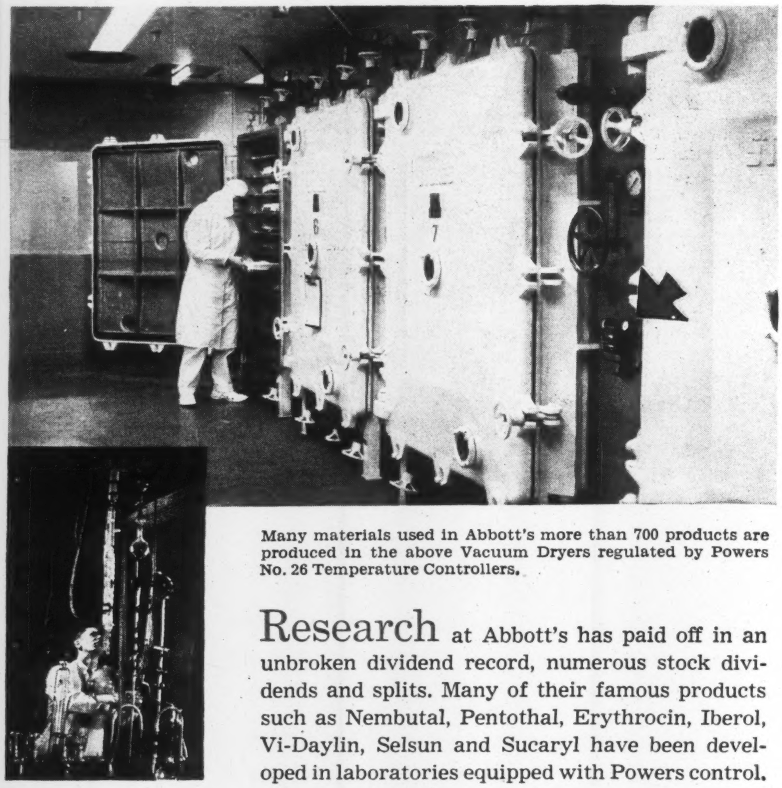
Vacuum Freeze Dryers equipped with Powers No. 26 Temperature Controllers.

Below: Air Conditioned Room for Board of Directors and executive conferences.



POWERS *AUTOMATIC* temperature, humidity and pressure control

....helps Abbott Laboratories bring better health to millions



Many materials used in Abbott's more than 700 products are produced in the above Vacuum Dryers regulated by Powers No. 26 Temperature Controllers.

Research at Abbott's has paid off in an unbroken dividend record, numerous stock dividends and splits. Many of their famous products such as Nembutal, Pentothal, Erythrocin, Iberol, Vi-Daylin, Selsun and Sucaryl have been developed in laboratories equipped with Powers control.

Versatility of Powers control used at Abbott's is indicated by some of the applications shown here and in the following installations: Air conditioning control systems for auditorium with 900 seating capacity, executive offices and dining room, cafeteria and animal rooms; also controls for tablet machines, demineralized water heaters, autoclaves and many other applications.

When you need automatic control for temperature, humidity or pressure, call your nearest Powers office or write us direct. An experienced Powers engineer will gladly help you select the right type of control and the proper size control valves.

(c42)

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

Over 60 years of Automatic Temperature and Humidity Control

For more information circle **23** on inquiry card.

Panhandle Pete

Picture Puzzles in the Sands of Time

WHILE idly thumbing through the April issue of *Instruments and Automation* and wading around through the advertisements recently, I came across this excellent piece of reportorial art on page 540. After admiring *my name* in print for a while my eyes fell down the page to the next story about "Changing the Watch" and I read about half of it before it dawned on me I wasn't reading anything about Watches at all but a rather lengthy discourse on Milton H. Aronson, Editor of the magazine. To you many constant readers of this magazine, M. H. Aronson is better known to the Pittsburgh instrument people as "Uncle Milton." This nickname conjures up a more friendly looking person than that portrayed by the picture of that sour-pussed individual on the bottom of the page to the left. Course I could be wrong. I got out of Tech at the same time Milton did and I'll be damned if this picture doesn't look like his graduation picture—taken lo these many years ago. That stern, I-know-it-all look most young engineers have plus the fact, if you'll look close, he hasn't begun to shave yet. Uncle Milton denies all this but look again for yourself.

Anyhow, as I read about changing watches I recalled many years ago a cartoon entitled "Dropping the Pilot." This showed Bismark, the old man, leaving the Ship of State and young Kaiser Bill leaning over the railing, watching the old man leave. Bill had a "watch me plow the ocean blue" look on his face. You all know what happened next—World War I, the atomic bomb, two-tone automobiles. And so I looked again at these two pictures at the bottom of page 540. What a depressing sight! Just think, in thirty more years our cheerful, exuberant Milton will have no hair, no teeth, no eyesight, can't eat, can't sleep, in short, he'll look like the Major. Sorta brings a lump to my throat just thinking about it for, in the words of the immortal bard, "I hates to see that evening sun go down."

And in the same issue of this magazine and on page 537 is a picture of Mr. John McLeod and Suzette, his wife. He's the fellow who writes this *Simulation Council Letter* thing which started in this April issue. Every time I look at that title I think it should be Stimulation Council. All us old men need both of those things. I read that first letter of his and I thought to myself "By gawd this guy is OK. He writes a clear, humorous, jaunty style and he knows what he is talking about. That's just what this magazine needs; something humorous!" Since reading that first letter of his I haven't been able to understand another one. We strap-hanger engineers in the steel mills must be thick in the head. Where was I? Oh, pictures. Anyhow, this picture is such a terror for the uninitiated. Look at him! Scared to death, a bashful man clinging to his wife's hand like a man clutching his last drink before the bar closes!

Panhandle Pete

Serving Industry—
FOR OVER 54 YEARS

PRECIOUS METAL WIRES
Produced in Platinum, Gold, alloys and pure metals—small diameter . . . Platinum alloy resistance wires... Pure Iridium and Rhodium-Iridium alloy Thermo-couple Wire.

BASE METAL WIRES
Very small diameter — for filaments, thermocouples, resistance units.

Metallurgists & Specialists in Small Wire

COATED WIRES
Comprising an extensive range of electroplated grid wires . . . Enamel insulated wires for precision resistors and potentiometers.

Write for Latest List of Products

SINCE 1901

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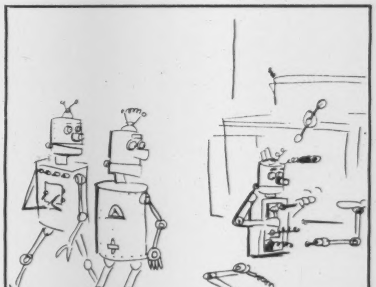
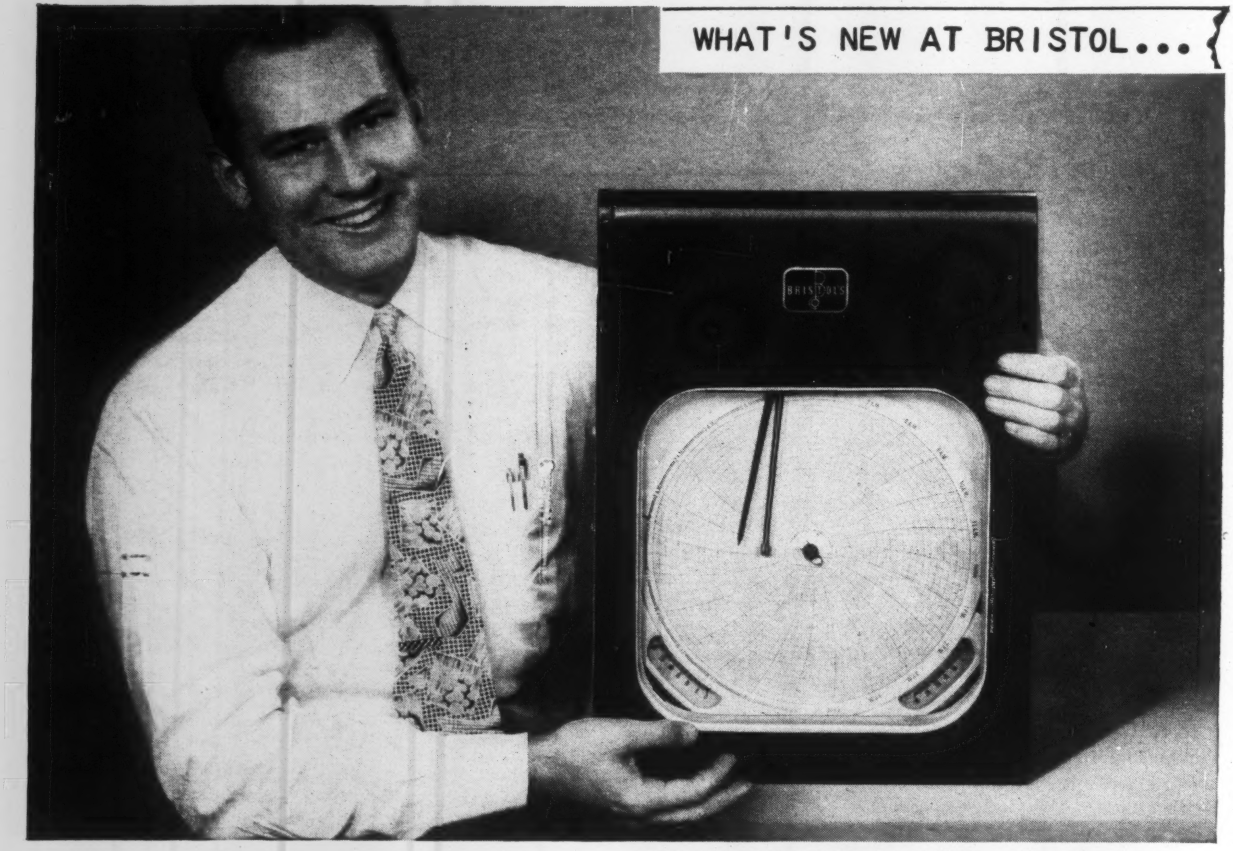


"NOW THERE'S TRULY A SELF-MADE MAN!"



WHAT'S NEW AT BRISTOL...

NEW BRISTOL 500EW Air-Operated Controller offers proportional band to 400% and reset-plus-derivative control.

New Bristol 500W Air-Operated Controller offers proportional band-width up to 400%

The new 500W Controller, latest addition to Bristol's 500 Series of Air-Operated Controllers, offers better control of difficult processes than ever before. The 500W features:

1. Wider proportional band allows control of difficult processes without cycling or instability. Choice of two band-width ranges from 1% – 200% or 2% – 400% of chart width, adjustable by user. Choice can be made by the user – no extra parts, no special tools, no calibration required.

2. Increased stability, without loss of sensitivity, for smoother control. New internal stabilizing elements insure freedom from short-period oscillations.

3. Wider reset response range to eliminate offset or droop errors in control. Standard reset rate of 0.1 to 10 repeats per minute or fast reset rate of 1 to 300 repeats per minute are available.

4. Increased derivative range, for better response to changing variables. Derivative time adjustable from 0.2 to 20 minutes. Bristol's exclusive zero derivative setting facilitates adjustment of controller to process.

5. Fixed links and levers give built-in calibration for greater accuracy, no misadjustment, low maintenance.

You'll find Bristol's widened line of Series 500 Air-Operated Controllers more than ever adaptable to your control problem – whether for controlling pressures, liquid-level, flow, temperature, motion, speed, pH, electrical values, or other variables. Why not get all the facts on these instruments? Write The Bristol Company, 113 Bristol Road, Waterbury 20, Conn. 5.35

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BRISTOL

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AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

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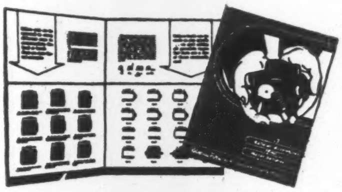
YOUR No. 1 SOURCE FOR COMPLETE BELLOWS ASSEMBLIES AND DEVICES

FULTON SYLPHON

BELLOWS HEADQUARTERS, U.S.A.

You gain three important advantages when you consult Fulton Sylphon, originators of the metal bellows—*1.* Over 50 years experience in bellows engineering is focused on your problem; *2.* Modern production facilities geared to good service; *3.* Cost saving opportunities through the design and production of complete bellows assemblies.



HERE'S HELPFUL INFORMATION

This 32 page catalog covers basic bellows engineering, conversion tables, metals available and other bellows data. Use the handy coupon for your free copy.

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CONTROLS COMPANY

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INSTRUMENTS and AUTOMATION News

Principles & Applications ....28 to 38
Stock Report 38
New Plants & Mergers ....41 to 42
People in the News ....45 to 46

BIZMAC Controls Army Inventory

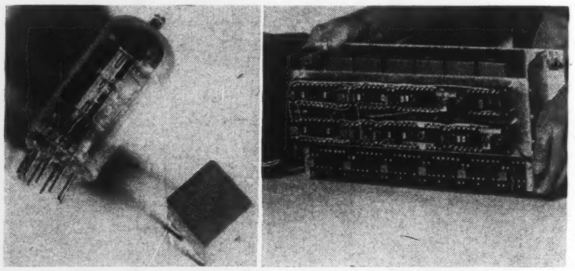
NEW YORK, N. Y.—The U. S. Army gets its briefing on the use of the $4,000,000 BIZMAC, which was built by the Radio Corporation of America to reduce inventory control procedures at Ordnance Tank-Automotive Command, Detroit. Magnetic tape is used for filing more than 2,500,000 letters and numerals on a single reel. Brig. Gen. Nelson M. Lynde is the customer while Arthur L. Malcarney, General Manager, Commercial Electronics Products, represents RCA.

Ceramics for Piezoelectric Transducers

WASHINGTON, D. C.—The usual piezoelectric transducer hitherto made from barium titanate has been outdated due to its temperature limitations. Researchers of the National Bureau of Standards have developed new lead-oxide-based transducers which are stable over ranges between 0 and 340°C as compared with the narrow range of 20 to 100°C for barium titanate. The most valuable composition in the new group (containing 45% lead titanate and 55% lead zirconate) also surpasses the old ceramic transducer in piezoelectric voltage output by more than 2:1. The new ceramics will be useful as sensing elements in accelerometers, sound detectors, sonar etc. and as drivers in ultrasonic devices.

Ferristorized EPUT Meter

CHICAGO, ILL.—One highlight of the Second Automation Exposition, Chicago, was this Berkeley Division of Beckman's new Events-Per-Unit-Time Meter which uses tiny magnets in place of vacuum tubes. Shown also is the long-lived Ferristor magnetic component which replaces the more short-lived electron tubes in the circuit. Berkeley exhibited a line of Ferristorized counter-controllers for industrial operations.



Iron & Steel Conference

PITTSBURGH, PA.—The following papers are among those to be presented at the forthcoming Sixth Annual Conference on Instrumentation for the Iron & Steel Industry, Hotel Webster Hall, Pittsburgh, Pa., March 5-6, 1956:

Telemetering for the Steel Industry. Authors: D. F. Young, Coordinator of Fuel and Power, Eastern Division, U. S. Steel Corp.

Instrumentation and Control of the Oxygen Steel Making Vessels at Bofanco. Author: D. O. Davis, V. P. Engineering; Co-Author E. Banks, Combustion Engineer, Dominion Foundries and Steel Ltd.

Cascade Furnace Temperature Control System. Author: Jack Hess, Assistant Fuel Engineer, Johnstown Plant, Bethlehem Steel Corp.

Combustion and Control on 80" Re-Heat Furnaces at Fairless Works. Author: L. W. Eisenhart, General Foreman Fuels and Instruments Fairless Works, U. S. Steel Corp.

Automatic Load Control. Author: O. H. Scammon, Chief Electrical Engineer, Allegheny Ludlum Steel Corporation, Brackenridge, Pa.

Combustion Control of New Surface Furnaces at Weirton Steel Co. Author: R. A. Francy, Assistant Superintendent Fuel, Weirton, West Va.

Gravimetric Blending and Controls in Sinter Plant Operation. Author: T. R. Zatkovich; Co-Author, B. E. Hamlett, B-I-F Industries, Inc.

Electronic vs. Pneumatic Control Systems. Authors: Charles Swartwout, Chief Engineer, Swartwout Company and V. V. Tivy, Chief Application Engineer, The Foxboro Co.

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CONTROLLED POWER FOR RESEARCH AND INDUSTRY
1956
CONDENSED STANDARD SPECIFICATIONS
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NOBATRONS
NOBATRON-RANGERS
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400-CYCLE INPUT NOBATRONS
TUBELESS REGULATED DC SOURCES
PRECISION REGULATED TUBELESS DC SOURCE
MAGNETIC RANGER
400-CYCLE AC REGULATORS

SPECIFICATIONS — PERFORMANCE DATA —

condensed information on regulated power equipment for every application

The new 1956 Sorensen condensed catalog gives you specifications on more than 65 different types of regulated power supplies — a cross section of Sorensen equipment engineered to create new standards of accuracy, dependability, ruggedness and appearance.

Included are new precision tubeless and transistorized AC and DC sources . . . a tubeless wide-range regulated DC supply . . . a 750 volt AC voltage reference source . . . heavy duty tubeless regulated DC sources for critical industrial applications . . . plus advanced versions of Sorensen's complete line of regulators and Nobatrons.

The new 1956 Sorensen catalog is a quick, one-stop guide to equipment for your needs — engineered, tested and backed by the reputation of Sorensen . . . "*the world's authority on regulated power.*"

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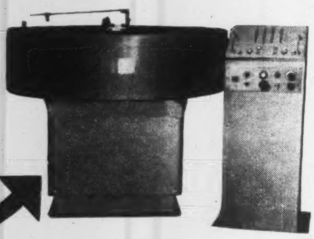

Use the SCHAEVITZ C-3-A ROTARY ACCELERATOR

TO TEST OBJECTS SAFELY...
UP TO 3 LBS. AT SPEEDS TO 800 RPM

You can safely test a wide range of instruments and components under various conditions of acceleration with the sturdy SCHAEVITZ TYPE C-3-A ROTARY ACCELERATOR. It offers the maximum combination of convenience and versatility in a machine of its size.

- it will operate at speeds to 800 rpm for a constant radial acceleration of over 250 G at a nominal distance of 14" from the center of rotation.
- the 34" aluminum rotating arm provides ample space for test objects up to a cube 6" on an edge.
- the removable guard and cover completely enclose the rotating arm and prevent damage if material under test fails.
- the spindle is driven through a "V"-belt drive by a compound wound d-c motor energized by a full wave electronic controller.
- speed adjustment is by means of a 10-turn helical potentiometer with an additional vernier potentiometer for very fine adjustments.
- speed indication is by means of an rpm pickup which feeds its signal into an electronic counter in the control console.
- eight slip rings provide electrical connections between stationary instruments, power sources and rotating test objects.
- the unit is sturdy and easy to operate and the framework is braced to prevent vibration.

Write, wire or call for additional specifications on this and other SCHAEVITZ rotary accelerators.

schaevitz machine works

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Just Published

AUTOMATION in the IRON & STEEL INDUSTRY

8¼ x 11¼, paperbound, 100 p.

Collection of papers from Fourth and Fifth Annual Conferences on Instrumentation for the Iron & Steel Industry.

". . . Volume is powerful, comprehensive coverage of automation in iron & steel industry . . . covers all aspects including blast furnaces, open hearths, rolling mills, etc."

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Instrument Short Course

WILMINGTON, CALIF.—The Fifth Annual Instrument Short Course, sponsored by the SCMA and Los Angeles Harbor Junior College will be held at the college, 1111 Figueroa, Wilmington, Jan. 26-27, 1956. Included will be instrumentation sessions, technician instruction, and exhibits of equipment.

Highlights of Automation Exposition

CHICAGO, ILL.—Potter Magnistor in a 3-dimensional memory with nondestructive readout, and a 15-Mc carrier to probe on-off condition, has advantage over coincident current cores in that power can be handled (cores give only mv output). Magnistor was shown also in binary adder featuring ½ usec carry time. Potter high-speed tape handler and reader now stops on the character being read.

Librascope LGP-30 unveiled for first time—unit is smaller than an average desk, yet has speed and memory capacity comparable to room-size units (drum memory has capacity of 4096 words of 30-hit length, plus sign and buffer, average access time of 8.5 msec but optimum access time of 2 ms). Effective increase in access time is done by use of an optimum address locator. Technique will be described in a feature article in the near future. Another eyeopener is the price: $29.800.

J. B. Rea Company of Santa Monica unveiled new REA-CONVERTER analog-to-digital converters and systems featuring up to 10,000 conversions/second and 30-microvolt resolution.

Clevite 32-inch digital scale shown for precision linear measurements to accuracy of 0.0005″; output in conventional binary code.

Bendix announced at the Automation Exposition that two important installations of their G-15A General-purpose digital computer. One in the research center of a large oil-producing company in the southwest (to assist in search for oil deposits) and one at power dispatching center of Bonneville Power Administration at Portland, Ore., on calculations of stream flow and reservoir storage for optimum power generation and transmission.

Comment by engineer at show: "There is more advanced instrumentation here than has ever been assembled under one roof before."

New TV broadcasting station costing less that $50.000 and integrated ITV systems for schools was revealed by Dage Television Div., Thompson Products.

Comment by engineer leaving Clevite-Brush computer clinic session: "You can learn more about the vast possibilities of these data handling equipments in a 2-hour session like this than in 100 hours of general reading—with the literature now available."

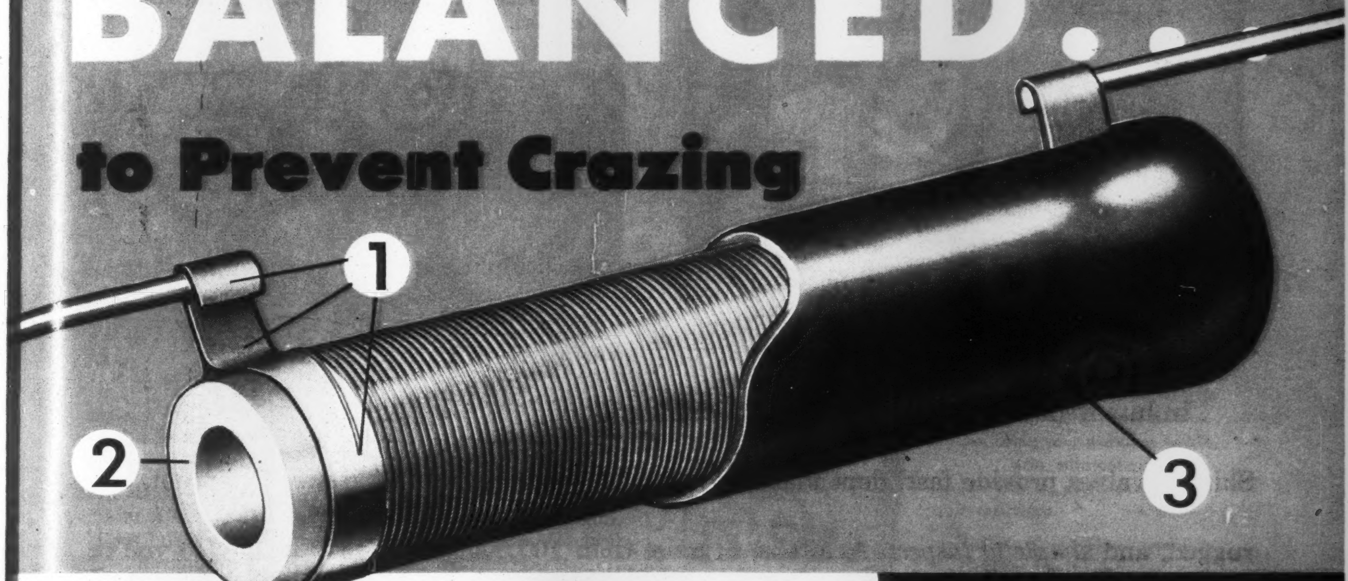
Berkeley unveils line of counters and EPUT meters featuring use of new Berkeley "Ferristor" elements (miniature magnetic amplifiers). Ferristors and Ferristor circuitry aroused great interest.

Kellogg stepless stepping switch with only one solenoid coil containing multinumbered armatures exicited many instrument men and engineers.

Comment by executive examining Pak-Rapid automatic packaging machine: "I have seen devices for automatically drilling the chassis, automatically wiring the circuit, automatically testing the circuit, and automatically con-

THERMALLY BALANCED...

to Prevent Crazing



OHMITE®

"Brown Devil"® RESISTORS

Ohmite "Brown Devil" Resistors have been carefully designed to provide *balanced thermal expansion.* All parts—core, resistance wire, vitreous enamel coating, and terminal band—have a thermal expansion that has been carefully matched. Consequently, Ohmite "Brown Devil" Resistors expand and contract as a unit. This eliminates cracking of the enamel, keeps terminals firmly anchored, and prevents the entrance of moisture.

THE RESULT: You are assured high-quality resistors that provide the utmost in dependability under the toughest service. Specify Ohmite "Brown Devils" on your next job.

They Last Longer!

1 PATENTED WELDED TERMINALS

Ohmite welded terminals provide a perfect and permanently stable electrical connection that is unaffected by vibration or high temperature.

2 HIGH TEMPERATURE STEATITE CORE

This strong, rugged, steatite core has excellent electrical characteristics, and a coefficient of thermal expansion that matches the other resistor materials.

3 EXCLUSIVE HIGH TEMPERATURE VITREOUS ENAMEL

This special-formula enamel was developed by Ohmite after extensive research. Its thermal expansion is properly related to that of the steatite core, terminal, and resistance wire.

Be Right with **OHMITE®**

OHMITE MANUFACTURING COMPANY, 2615 Howard Street, Skokie, Illinois (Suburb of Chicago)

RHEOSTATS • RESISTORS • RELAYS • TAP SWITCHES

For more information circle **28** on inquiry card.

25,000,000 CYCLES*

Skinner solenoid valves V9 Four-Way are ideally suited for use in high-speed production lines. They perform lubricating, cylinder control, blowing and ejecting functions in hundreds of applications, such as drilling stamping, pressing and riveting. Skinner valves provide fast, dependable and trouble-free operation. They're leakproof, rugged, and *simple to inspect*. Available in more than 100,000 variations, V5 Universal so you're sure of finding the valve that is perfect for *your* particular application. Call in a Skinner engineer *first* to help you with your solenoid valve problem. With us, no problem is too great, no quantity is too small. Write for Skinner's new solenoid valve catalog . . . on your letterhead, please.

*Special Skinner solenoid valves have proven operable up to 25,000,000 cycles in specific applications.

SKINNER

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SOLENOID VALVES

THE CREST OF QUALITY

SKINNER ELECTRIC VALVES

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WORLD-WIDE REPRESENTATION

For more infromation circle 29 on inquiry card.

veying it between all operations. I guess this automatic packaging of the finished product is the final step in the automation picture."

Selenium Diode Contest Winner

LOS ANGELES, CALIF.—The International-Rectifier-Corp.-sponsored contest to find new applications for selenium diodes was won by Harry J. Kayner, Senior Research Engineer at North American Aviation's Advance Plant. The picture shows Dr. Lee De Forest handing the winner the keys to a new Ford car awarded to him. Looking on are J. T. Cataldo (right), Assistant General Mgr., International Rectifier, and F. W. Parrish (left), the company's Chief Design Engineer.

Research Engineer of 1970

PITTSBURGH, PA.—The picture shows young Kenneth John, 7, impressing his sister Sharon Kaye, 9, with his wiring connections that can make various pilot lamps light up. Their father, John C. Stewart, photographer at Jones & Laughlin's Research Center in Pittsburgh, rigged up the battery powered contraption, snapped the picture—and we think you would like to meet the future Edison.

Your plant is in this picture

It might as well be YOUR plant, for in it, Kirk & Blum can bring your drawings to life . . . with substantial savings for you in costs and capital investments.

Kirk & Blum offers complete facilities for the fabrication of sheet and plate to 1/2" thickness—and light structurals. We specialize in aluminum, monel, stainless and other alloy fabrication.

In the modern 150,000 sq. ft. Kirk & Blum plant is to be found the latest metalworking equipment available, operated by skilled sheet metal craftsmen. Overhead cranes, to 25 ton capacity, serve entire assembly areas and interior rail siding. A new warehouse contains extensive inventories of materials. Coordinated for speed, versatility and accuracy, these facilities assure successful and economical completion of your products.

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SHEET METAL FABRICATION

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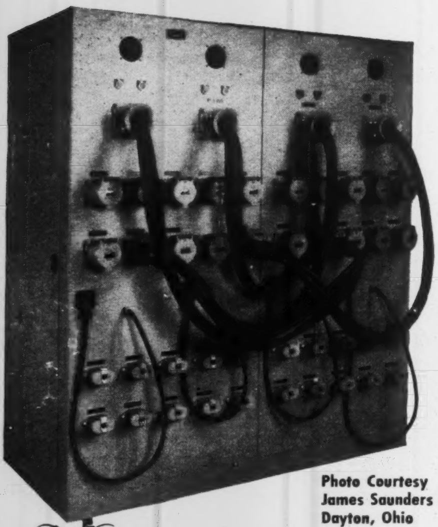
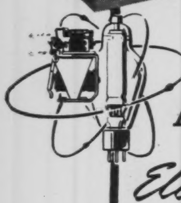


Photo Courtesy
James Saunders Co.
Dayton, Ohio



BETTER AUTOMATION
REQUIRES BETTER
Electrical Connectors

Downtime is Automation's most relentless enemy. That's the reason every link in a production chain should be carefully selected. Electrical Connectors in power feeder and control circuits, for example, must do more than merely meet electrical specifications. To provide dependable long-lasting service they must also be highly resistant to damage by oils, acids and rough handling . . . and when connected, must not permit moisture or dust to contaminate their contacts. JOY one-piece Neoprene insulated connectors meet all these requirements and they're available in a wide variety of single and multiple-contact designs. Want more facts? Ask and we'll mail them . . . ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** *In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

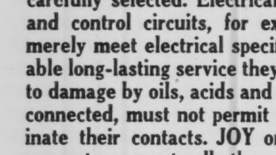
and **JOY** *Connectors are better Electrical Connectors*

OIL SEALED — One-piece molded cable/connector assembly protects conductors from oil and other external impurities.

DISTORTION-PROOF — JOY Connectors cannot crack, will not shatter and are practically impossible to knock out of shape.

MOISTURE-TIGHT — Water cannot penetrate one-piece, molded body and face seals protect contacts when connectors are engaged.

CD 156.1



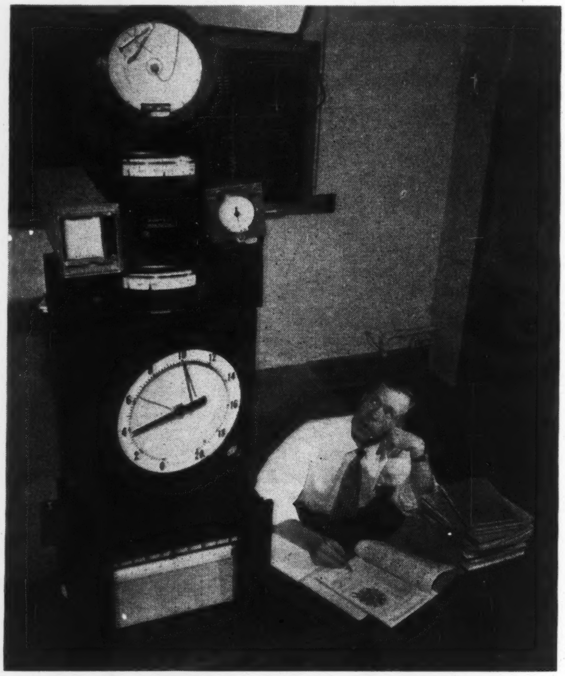
Free . . . **New Bulletin — Ask for No. B59**

JOY
SOURCE OF INDUSTRY'S FAVORITE ELECTRICAL CONNECTORS SINCE '28

For more information circle **27** on inquiry card.

Needed: Robot Brains

PHILADELPHIA, PA.—The advent of automation has brought countless manhour savings, but also headaches to many engineers who feel the need of "hitting the book" again to keep up with the developments. This student at Brown Instrument Division's school looks awed by the totem pole of controllers he is supposed to be able to dismantle and reassemble into operating condition when he becomes one of the graduates of the school. Some 4,000 have done it before him!

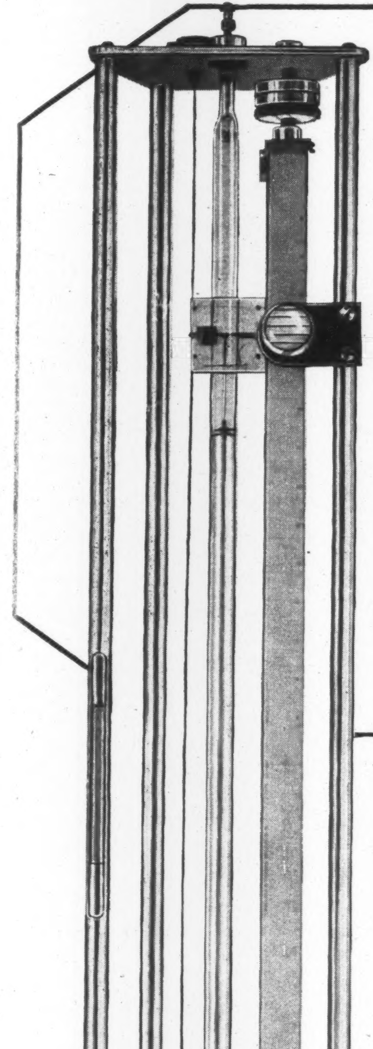


Determination of Color Differences

WASHINGTON, D. C.—The National Bureau of Standards has published encouraging results of preliminary phases in its long range program to determine color differences by colorimeters. Although a panel of color experts and lay observers differed widely among themselves and the instrument used for the demonstration, it appears that the results obtained from the instrument are more reliable than when the human element is inserted. The help of special analog computers to integrate spectrophotometric curves of small color differences favor the instrument's reliability over human judgement.

Gas Meters Used to cut Phone-Line Maintenance Costs

BROWNSVILLE, TEXAS—Bell Telephone has used dry compressed air in cables since the end of World War II to protect paper and pulp insulation on the conductors from damage by moisture. A compressor and air-dryer system supplies 10-psig air at 40°F dewpoint. Dry-type



MERCURIAL-PRECISION STANDARD

Type FA-187

Measures Absolute or Differential Pressure

Used interchangeably as a Barometer or Differential Pressure Manometer.

Range: 0 to 800 mm of Hg.
0 to 31.5 in Hg. or in any other desired pressure unit of equivalent range.

The magnetic vernier reads to 0.01 mm or 0.005 in. of mercury with an accuracy of 1 part in 5000 over the full range.

For additional information,
write for Publication Number TP-32-A.

WALLACE & TIERNAN
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PRECISION INSTRUMENTS AND ELECTRICAL MECHANISMS
25 MAIN ST., BELLEVILLE 9, N. J.
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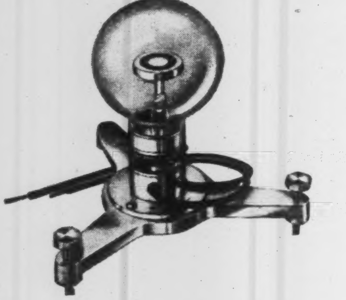
For more information circle **32** on inquiry card.

EPLAB

PYRHELIOMETER
For the Measurement of
SOLAR RADIATION



Eppley Pyrheliometers are used for solar radiation measurements at ninety-eight weather stations in the continental United States, Canada, Alaska, Greenland, Iceland, Caribbean Sea, and the Pacific Ocean. Sixty-two of these stations are under the direction of the United States Weather Bureau.

The Eppley Pyrheliometer was adopted as standard equipment by the Weather Bureau after considerable experimentation. It was found to be the best instrument so far tested by the Bureau.

Used in conjunction with a suitable recorder, the Eppley Pyrheliometer will provide an accurate and reliable record of total solar and sky radiation on a horizontal surface.

Bulletin No. 2 on Request

THE EPPLEY LABORATORY, INC.

Scientific Instruments

2 Sheffield Ave.
Newport, Rhode Island U.S.A.

For more information circle 34 on inquiry card.

gas meters are now used to measure air consumption. Leaks in cable sheaths show up by periodic comparison readings. Far better results are reported by districts using this method, and trouble can be shot before it becomes serious.

News Bits

1955 EDISON MEDAL has been awarded to L. A. Umansky, manager of engineering, Industrial Engineering Dept., G. E., Schenectady for "application of electrical machines, devices and systems to automatic process machinery."

NORTH AMERICAN AVIATION'S new transistorized digital computer can simultaneously integrate 93 quantities and consumes only 100 watts, against 3000 watts of a tube unit with half its capacity.

PNEUMATIC-ELECTRONIC SYSTEM build by the Brown Division of M-H synchronizes the pumping rate of the various substations into the world's longest crude oil pipe line from Alberta to Ontario (1700 miles).

BUILDERS-PROVIDENCE contributed to the engineering of the atomic-powered submarine Nautilus by supplying a 14-inch stainless-steel Venturi insert nozzle used as primary flow element under the existing high-pressure, high-temperature conditions.

FELLOWSHIPS in System Engineering toward a Doctor's degree at Cal. Tech or MIT have been announced by The Ramo-Wooldridge Corp. of Los Angeles.

AUTOMATIC NAVIGATOR AN/APN-66 designed by General Precision Laboratory, Pleasantville, N. Y. recently steered the Navy's WV-2 Super Constellation automatically 55 miles to a pinpoint destination.

NUCLEAR MEASUREMENTS CORP. of Indianapolis has come out with a trailer-mounted monitor to record airborne radioactivity on filter paper tape.

REGISTER BY TELEVISION at the Temple Hotel when you drive to Pendleton, Oregon. DuMont has set up a 2-way closed-circuit system that enables the hotel guest to communicate with the desk clerk without getting out of the car.

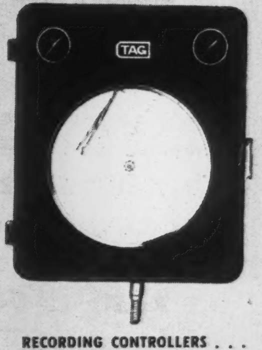
SMOKE CONTROL TECHNIQUES will be discussed on January 31, 1956 at AIEE's electrostatic session in New York with papers (1) "Measurement of Charge Imparted to Fine Particles by a Corona Discharge," (2) "The Charging of Small Particles for Electrostatic Precipitation," (3) "A New Technique for the Measurement

to regulate and record—

TEMPERATURE.. PRESSURE.. VACUUM..TIME

mechanical instruments by WESTON

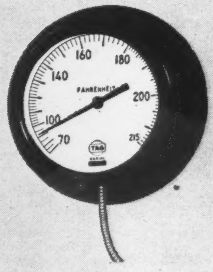
RECORDING INSTRUMENTS . . . in 9", 10" and 12" chart sizes — single and multipen — for all requirements.



RECORDING CONTROLLERS . . . handle temperatures from −325°F to 1000°F—vacuum to 30" mercury — pressures to 7500 psi or higher.

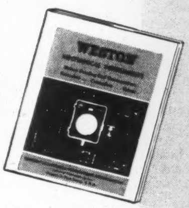
TIME CONTROLLERS . . . make any semiautomatic retort control system fully automatic. Available in both standard and special forms.

INDICATING CONTROLLERS . . . accurately regulate temperature, vacuum, pressure and indicate on direct-reading scale.



DIAL THERMOMETERS (remote reading) . . . furnished with mercury, gas, or vapor pressure actuations. Flush or wall mounting. Indicate low as −325°F., high as 1000°F.

Just Published!



Just published . . . the new catalog M2A which fully illustrates and describes the comprehensive line of WESTON mechanical instruments, noted for their long-time accuracy and dependability. Send for your copy today; or ask your local Weston representative for help on any measurement or control problem involving temperature, vacuum, pressure. Weston Electrical Instrument Corporation, 614 Frelinghuysen Ave., Newark 5, N. J., *a subsidiary of Daystrom Inc., 200 Elmora Ave., Elizabeth, N. J.*

WESTON *Instruments*

For more information circle **33** on inquiry card.

BORG MICRODIAL

DIRECT READING THROUGH 3600° TO A DIGITAL ACCURACY OF 1 PART IN 1000.

FITS ANY MULTI-TURN DEVICE HAND OR SERVO OPERATED

● The new direct reading Borg Microdial Model 1301 practically eliminates human error because it was designed for forced fast reading. Laboratory, production and processing controls become more accurate when clear, sharp, figures on the specially designed Borg Counter are observed through the focal-point window. Borg Counter figures are seen against a dull black background to provide maximum contrast for instant perception under difficult reading conditions.

The specially designed Borg Counter in the Model 1301 Borg Microdial reads from 000 to 999 to 000 in 3600 degrees of continuous rotation with no stops. Maximum recommended operating speed is 10,000 counts per minute (100 rpm).

Designed for military application, it has a built-in dust shield and clear-vision, wide-angle window for accurate reading from almost any position in front of the dial.

The Model 1301 Borg Microdial is compact. It measures only 1-3/4" in diameter and 1-5/8" in height and occupies no more panel space than the Micropot it controls.

WRITE FOR CATALOG SHEET BED-A31

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
JANESVILLE, WISCONSIN

For more information circle **41** on inquiry card.

of Corona Field Strength and Current Density in Electrical Precipitation," (4) "Proposed Industry Standards for Electrostatic Precipitation Power Supply Equipment," (5) "Practical Applications of Electrostatic Phenomena to Particulate Matter."

VACUUM METALS CORP., Syracuse, jointly owned by Crucible Steel Co. and National Research Corp., last month tapped its new 2200-pound vacuum melting furnace which will add 60 to 75 tons per month to satisfy demands for high quality steel used by atomic energy, aircraft, tool steel industry, etc.

COLEMAN ENGINEERING CO., Los Angeles, announced development of a new type of surface coating to reduce friction drag on underwater vessels and weapons. A new principle in hydrodynamics is claimed to have been proved.

UNITED AIR LINES is now handling 3,000,000 messages monthly at its new telegraph switching center at Idlewild Airport, New York, one of six centers on the company's 30,000-mile private telegraph network, leased from Western Union. Teleprinter at place of origin, perforated tape at the New York Center, and print out devices at receiver station form the links for the messages.

Stock Report

The following prices and price ranges are supplied by Bache & Co., 36 Wall Street, New York 5, New York

New York Stock Exchange:

Security	Price Range for Year Thru November 30 High	Low	As of November 30 Last
Aeroquip Corp.	17 1/2	8 1/2	14
American Chain & Cable	46 3/8	35 1/2	42 1/4
American Mach. & F.	35 7/8	23 1/4	25 3/4
American Mach. & M.	41 3/8	27 1/2	37
American Optical	53 1/4	38	39 1/2
Beekman Inst.	26 7/8	19 3/8	25
Bell & Howell	42 1/4	30 1/2	31 3/8
Bendix Aviation	59 1/2	45	56 3/4
Bulova Watch	25 3/8	21 3/4	22
Burroughs	34 1/4	22 7/8	29 1/4
Clevite	25 3/8	20 1/2	21 1/4
Dobeckmun	38 7/8	30 1/4	35 3/8
Gamewell	39	29 1/2	30 5/8
General Inst.	13	7 5/8	8 5/8
General Prec.	71 1/2	36 1/2	45
General Time	39 3/4	31	32
Hamilton Watch	25 1/4	18 1/4	21 1/4
International Business Mach.	450	349	397
Minneapolis-Hon.	70	50 1/8	59 3/4
National Cash Reg.	47	33 7/8	36 1/2
Radio Corp.	55 3/8	36 3/4	45 7/8
Raytheon	25 3/4	13 7/8	17 1/4
Robertshaw-F.	33 5/8	26 1/2	27 7/8
Sangano Electric	30 3/8	25 1/2	29
Sperry Rand	29 5/8	21 1/4	25 1/2
Square D	52	40 1/2	51 1/8
L. S. Starrett	50	40 3/4	43 3/4
Sylvania Elec.	49 7/8	41	44 7/8
Telautograph	37 1/2	25 1/2	28 5/8-29 (1)
Texas Inst.	16 7/8	10 1/8	13 1/8
Underwood	43 1/8	33	36 1/2

(1) Bid - Ask price, no sale.

American Stock Exchange:

Security	Price Range for Year Thru November 30 High	Low	As of November 30, Last
Air Assoc.	12 3/4	7 3/4	9 1/8
American Meter	40	32	34 - 34 1/2 (1)
Benrus Watch	10 7/8	9 1/2	9 3/4
Breeze Corp.	9 3/8	5 3/4	7
Consolidated Electrodynamics (2)	31 1/4	20	24
DuMont Labs.	17 1/8	9 3/4	9 7/8
ElectroData	17 7/8	10 3/8	12 3/4 - 12 7/8 (1)
Fairchild, C. & I.	37 1/4	21	23 5/8
Int'l Resistance	12 3/8	5	8
Lear Inc.	13 3/8	7 1/4	8 1/4
Nat'l Res. Corp.	33 1/4	17 3/8	18 1/2
Neptune Meter	33 1/2	21	33 1/4
New Haven Clock	4 1/8	2 3/8	2 1/2
Norden-Ketay	19 1/2	11 3/8	12 5/8
Pneumatic Scale	31	27 1/2	26 5/8 - 27 3/4 (1)
Servomechanisms	13 3/8	8 1/4	9 1/8
Wallace & Tiernan	26 7/8	19 1/2	21 7/8
Waltham Watch	2 7/8	1 3/8	2 1/4

(1) Bid - Ask price, no sale.

(2) Name change from Consolidated Engineering.

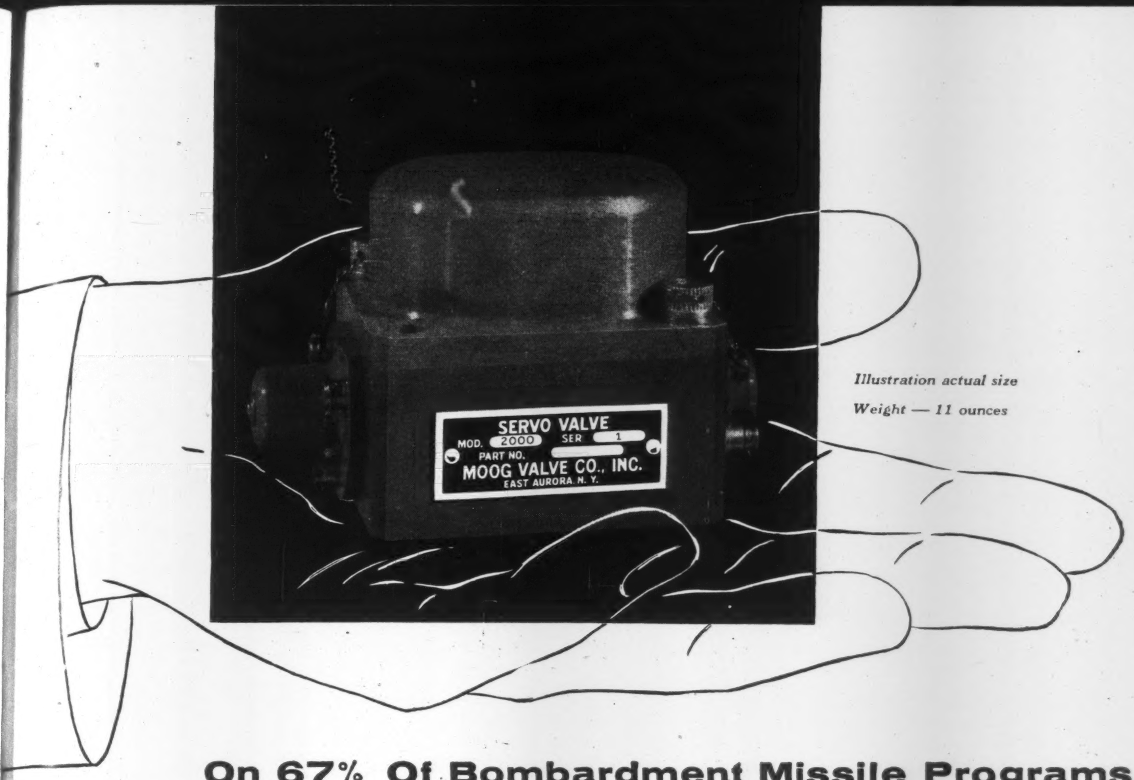


Illustration actual size

Weight — 11 ounces

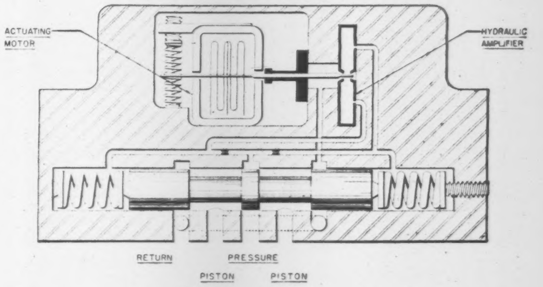
On 67% Of Bombardment Missile Programs
On 50% Of Fighter Aircraft Programs

Many thousands of Moog Servo Valves are now in use in exacting applications on advanced aircraft and guided missiles. This widespread usage attests to Moog features of reliability and high performance which have gained for these units recognition as the industry standard.

Now, these same features may be obtained in Moog's new Dry Solenoid Servo Valves. These units, illustrated above by Model 2000, feature a torque motor that is isolated from contact with the hydraulic fluid. The Dry Solenoids have been developed for those systems in which the fluid might otherwise contaminate the torque motor. They are even smaller and lighter than other Moog units of the same flow capacity and comply with requirements of MIL-H-5440A.

Moog Servo Valves are proportional type, electrically actuated, hydraulic, four-way valves featuring high dynamic response, sensitivity, linearity, small size and low weight. Production models are designed to operate in hydraulic systems of from 1000 to 3000 PSI pressure. Rated output flows from 0.1 to 50.0 GPM for control currents between 2.0 and 40.0 milliamperes as specified are available in production units.

Conventionally, valve input is from a balanced push-pull DC amplifier and valve flow output is applied to a piston or hydraulic motor. An electric signal proportional to piston position or motor angular rotation is fed back to the amplifier to give a closed servo loop.



MOOG

For details write for Bulletin 2000-3

MOOG VALVE CO., INC. **PRONER AIRPORT** **EAST AURORA, N. Y.**

For more information circle **35** on inquiry card.

Long-Lasting, Constant-Voltage

MALLORY
Mercury Batteries

For your portable instruments

MALLOR
TR-132R
2.5 VOLT
MERCUR
TRANSIST
POWER SU

Portable thermistor-type temperature indicator uses Mallory battery No. TR-132R.

To power the portable instruments you are designing, it pays to incorporate the unusual performance of Mallory Mercury Batteries. They give you a power source that offers the tops in long life and dependability. In the temperature indicator pictured here, Mallory Mercury Batteries deliver more than 500 hours of continuous operation ... in the radiation detector, more than 100 hours.

Their constant-voltage, constant-current discharge protects against changes in instrument accuracy. Mallory Mercury Batteries, moreover, can withstand long periods of storage and extremes of temperature and humidity without deterioration. And they are so small that they fit readily into miniaturized, light-weight equipment. Their constant-energy characteristic is ideally suited to use in transistor circuits.

A wide selection of capacities and voltage ratings is available. For complete data on Mallory Mercury Batteries, write today for our latest Technical Bulletin.

Portable radiation monitor can run two weeks continuously on its Mallory Mercury Batteries ... or up to 2 years on intermittent service.

Parts distributors in all major cities stock Mallory standard components for your convenience.

Serving Industry with These Products:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

Expect more...
Get more from

P. R. MALLORY & CO. Inc.
MALLORY

P. R. MALLORY & CO., Inc., BATTERY DIV., NORTH TARRYTOWN, N.Y.

For more information circle **36** on inquiry card.

New Plants and Mergers

AUTOMATIC ELECTRIC CO. will build new $16-million research lab and general office structure, announces *L. H. Warner*, Pres.

PERKIN-ELMER CORP., Norwalk, Conn., announces purchase of Warren Electronics, Inc., well known for the "Spectracord."

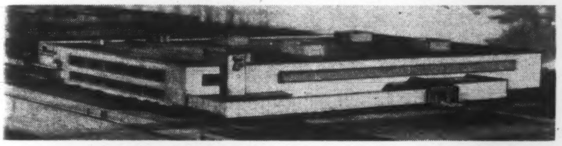
C. P. CLARE & CO. announces opening of a new production unit at Fairview, N. C., for relays and switches.

HAYS NEWS—*Phil Sprague, Jr.*, executive vice president of Hays Corp., announces reorganization plans which will include a new Hays and Metrotype Div. *Donald R. Schoen*, vice president of manufacturing, has been named manager of the Hays Div., and *Robert E. Navin*, in charge of engineering, was named manager of Metrotype Div.

HEILAND DIV. of M-H opens new $1-million 45,000-sq. ft., one-story plant, located on a nine-acre plot in Arapahoe County, Denver, Colo.

ALLEGANY INSTRUMENT CO. has consolidated its office and factory at their new 34-acre tract atop Will's Mountain overlooking Cumberland, Md.

PACIFIC DIV. OF BENDIX AVIATION CORP., announces completion of their engineering building on Sherman Way in N. Hollywood, Cal.



BENSON-LEHNER CORP., has moved to new quarters at 11930 Olympic Blvd.

FOXBORO—*W. H. T. Furry*, Director of Training, announces plans for expansion of Foxboro's Training and Education Center. *Norman A. Anderson* and *John B. Parkes, Jr.*, have been appointed training staff instructors.

P. R. MALLORY (Huntsville) Inc., an affiliate of P. R. Mallory & Co. of Indianapolis, has opened a new manufacturing plant in Huntsville, for the production of electrolytic capacitors.

ELECTRODATA CORPORATION, Pasadena, has dedicated the first of two new computer plant facilities in Pasadena's scenic Hastings Ranch. The new plant costs $525,000, provides 40,000 sq. ft. of space. Consolidated is

FREE BOOKLET
. . . shows how Elgiloy can help save corrosion problems for you.

ELGILOY
. . . another product backed by famous ELGIN quality!

It's a completely new spring material . . . fatigue and corrosion resistant beyond any other alloy available. Leading industries now use it to improve performance of springs, valves, instruments. Write today for the ELGILOY Booklet.

ABRASIVES DIVISION, DEPT. T
ELGIN NATIONAL WATCH COMPANY
ELGIN, ILLINOIS

For more information circle 67 on inquiry card.

news notes from Berkeley division
BECKMAN

A Totally New Concept of Industrial Instrumentation

Berkeley MAGNETICS

bring you high speed counting and control without vacuum tubes, offering:

★ CONTINUOUS-DUTY RELIABILITY
★ LONG SERVICE LIFE
★ INSTALLATION, OPERATION, SERVICING BY REGULAR PLANT PERSONNEL

New Ferristor* equipped Series 5840 Dual Preset Counter Controller, and new Model 7650 EPUT* meter now available. Write or wire today for data, prices! Please address Dept. B-1.

Berkeley division
BECKMAN INSTRUMENTS INC.
2200 Wright Avenue • Richmond 3, Calif.

*Trademark
76

For more information circle 68 on inquiry card.

fully-opened...
fully-closed
with the
flick of a finger

HOKE
toggle valves

Hoke toggle valves open and close with a single, positive motion like flipping a light switch. Use them on your precision test equipment for gas or liquid control at pressures up to 1000 psi. Seat and stem seals are tight enough for most high vacuum work.

In instrument panel service you can tell instantly that the valve is open (or closed) and the colored nylon handles identify fluids at a glance.

Available in angle and globe patterns in brass or stainless, 1/8" through 1/2" pipe (or with tube fittings).

May we send you catalog and data sheets?

HOKE
HOKE
INCORPORATED
Fluid Control Specialists
231 S. DEAN STREET, ENGLEWOOD, NEW JERSEY

For more information circle 39 on inquiry card.

PLANTS & MERGERS—CONTINUED

now third ranking computer firm nationwide, with 400 employees and sales this year exceeding $3-million.

CONOFLOW—*Rudolph B. Werey*, president of Conoflow Corporation, Philadelphia, announces an exchange-of-stock agreement between Conoflow Corporation and the Walworth Company. As a result of this agreement, Conoflow will become an operating subsidiary of the Walworth Company effective January 3, 1956.

Conoflow has recently expanded its Philadelphia sales office operations, according to a recent announcement by *John C. Koch*, Vice President in Charge of Marketing. *Harry J. Hartz* has been appointed District Manager.

GLEGG LABS., INC., Morristown, N. J., announces expansion of engineering and production facilities in their new plant in Morristown, N. J.

SANBORN COMPANY announces plans to construct a new $1,500,000 122,000-sq-ft office and manufacturing plant, to be built and leased under the Cabot, Cabot & Forbes Co. Package Plan. It will front on the East Side of Route 128 in the Waltham Industrial Center.

NEPTUNE—Directors of Eastern Industries, Inc., announces acceptance of the proposal to be combined with the Neptune Meter Co. of New York.

AIC—*Leonard W. Cronkhite*, president of Atomic Instrument Co. announces AIC shipments in 1955 are expected to top the million-dollar-mark for the first-time.

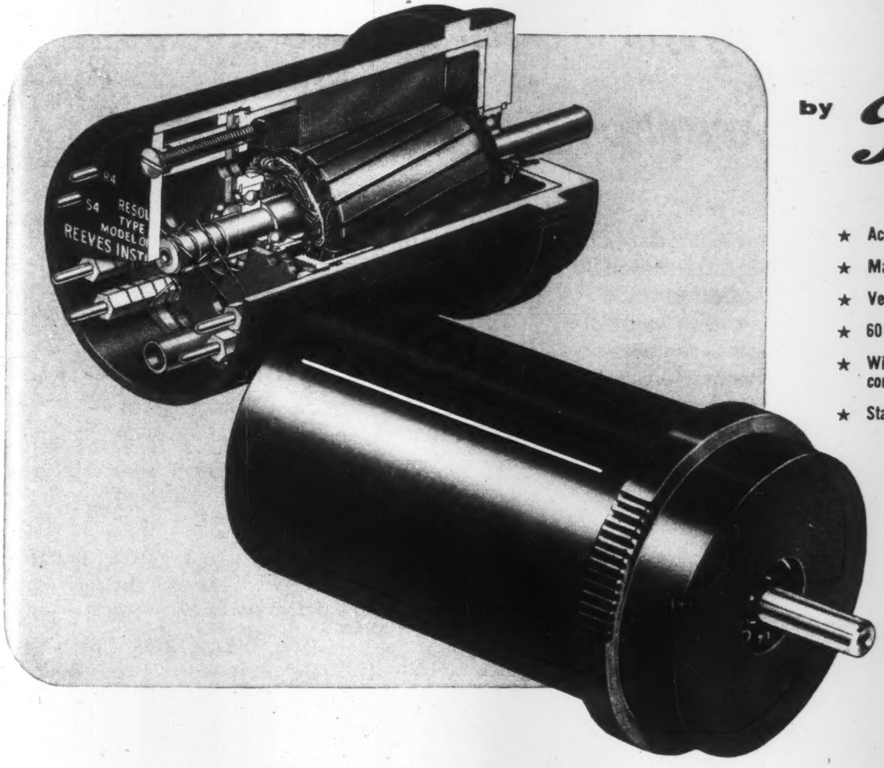
ROCKWELL MFG. CO., Pittsburgh, announces construction of two new 100,000-sq-ft plants in Russellville, Ky., and Porterville, Calif. Negotiations for purchase of a third plant are being made.

RAMO-WOOLDRIDGE CORPORATION, Los Angeles, has secured options on 800 acres of land in the southern part of Denver to provide for the future erection of a manufacturing facility, according to an announcement today by *Dr. Dean E. Wooldridge*, Pres.

DOLLINGER CORPORATION, Rochester N. Y., manufacturers of industrial filters, has announced the appointment of Malcolm W. Black & Co., Inc., New York City, as sales representatives for New York City, Northern New Jersey, and Westchester County, effective January 1, 1956.

NEW AGENCY—Muller, Jordan and Herrick, specializing in sales promotion and visual programs, has been announced by the partners, *Frank B. Muller*, *John T. Jordan*, and *William F. Herrick*, all former members of the Advertising and Sales Promotion Department of the General Electric Company. The firm is located at 235 East 50th Street, in New York.

PRECISION RESOLVERS



by Reeves INSTRUMENT CORPORATION

- ★ Accuracy better than 0.05%.
- ★ Maximum interaxis error as low as 1′.
- ★ Very low distortion.
- ★ 60 or 400 cps. or wide band.
- ★ With or without booster amplifier compensation.
- ★ Standard military frame sizes.

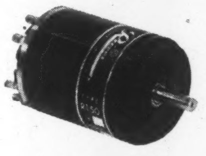
the HIGHEST PRECISION resolvers available

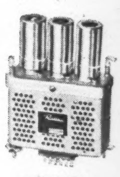
Reeves' many years of experience as a pioneer in the field has made it possible to manufacture these compact precision resolvers in quantity production to a functional accuracy of 0.05% without culling—or to an accuracy of 0.03% on special order. Harmonic distortion and null voltages are held below one-tenth of one per cent.

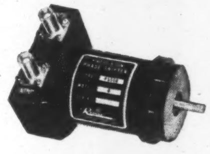
Reeves resolvers are primarily designed for 60 and 400 cps. operation, with or without booster amplifier compensation. Special units are available for use at over 100 kc bandwidth. The Reeves R600 series is the standard of comparison among precision resolvers. Miniature resolvers of highest precision are also available.

Write for the Reeves Resolver Handbook.

REEVES PRECISION RESOLVERS AND RELATED COMPONENTS


MINIATURE PRECISION RESOLVERS


BOOSTER AMPLIFIERS


PHASE SHIFTERS

CONTINUOUS RESOLVER CHECKER

Reeves INSTRUMENT CORPORATION

REEVES INSTRUMENT CORPORATION
A Subsidiary of Dynamics Corporation of America
225 East 91st Street, New York 28, New York

2RV56

For more information circle **37** on inquiry card.

New ATLANTIC Reformer at Atreco Refinery features Swartwout Autronic Control

Atlantic's Catforming means high octanes . . . high yields . . . low cost . . . proved performance. And for its new Catformer at the Atreco Refinery, Atlantic specified Swartwout's Autronic Control System—the revolutionary step forward in sensitive, precise process control.

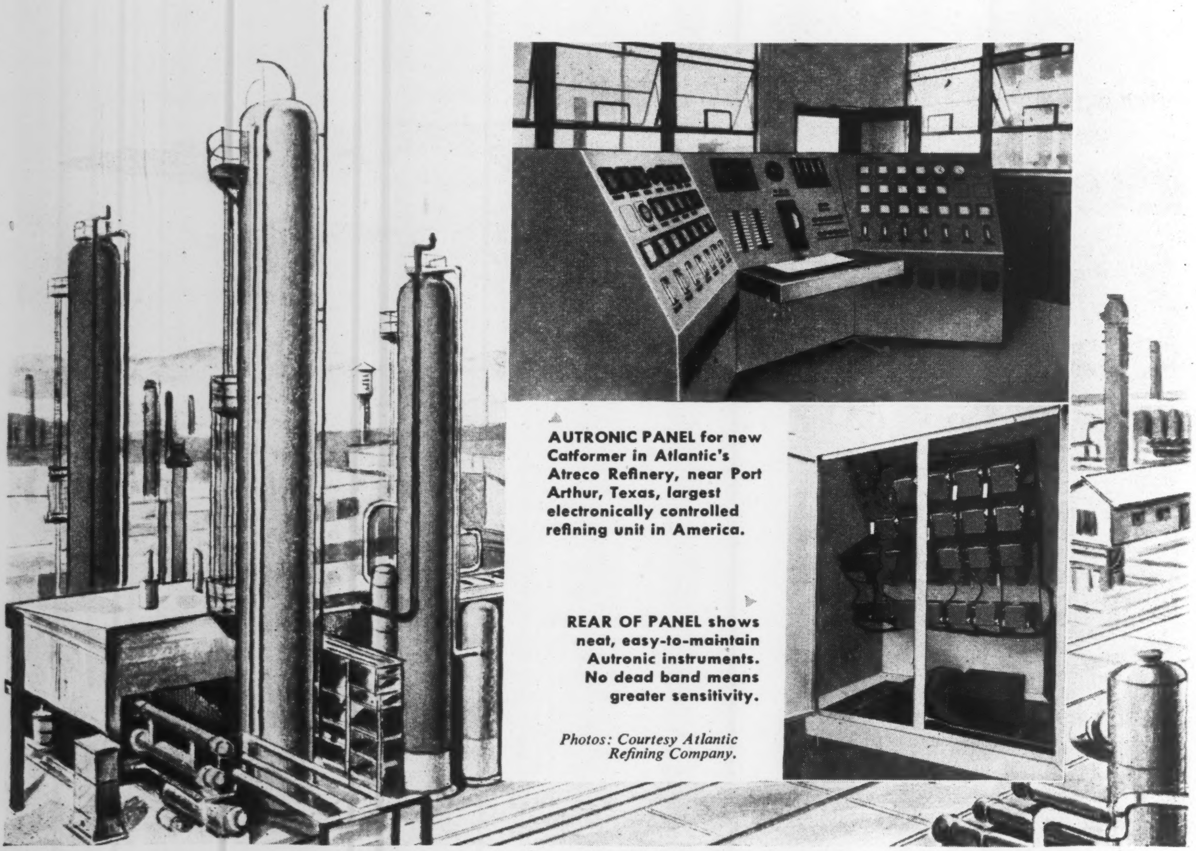
It senses . . . controls . . . indicates and records pressures, temperatures and flow. And the Autronic System does it electronically without boosters, slide wires, motors or troublesome air lines.

Call in our engineering representative to explain how the Swartwout Autronic Control System can bring new accuracy and speed to *your* process instrumentation. Or write today for literature on the *proven* Swartwout Autronic Control System.

AA-889

Swartwout Autronic CONTROL SYSTEM

THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12 • OHIO



AUTRONIC PANEL for new Catformer in Atlantic's Atreco Refinery, near Port Arthur, Texas, largest electronically controlled refining unit in America.

REAR OF PANEL shows neat, easy-to-maintain Autronic instruments. No dead band means greater sensitivity.

Photos: Courtesy Atlantic Refining Company.

For more information circle **38** on inquiry card.

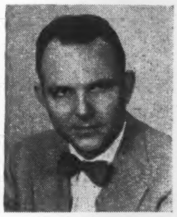
People IN THE NEWS

SERVOMECHANISMS INC., announces appointment of *Ralph W. Barnes* as customer liaison manager of the company's Eastern Div.

PIERSON JOINS EGGELHOF—*Robert Molnari,* vice president of Eggelhof Engineers, Inc., announces appointment of *T. H. Pierson* as vice president of Eggelhof. Pierson is a leading personality in the instrument industry.

Ralph W. Barnes
Servomechanisms

T. H. Pierson
Eggelhof Engrs.



Z. R. Smith
Potter & Brumfield

POTTER & BRUMFIELD—*James Rinke,* director of engineering for Potter & Brumfield, Princeton, Ind., announces appointment of *Zeke R. Smith* as chief engineer of applications.

LIBRASCOPE, INC., Glendale, Calif., announces appointment of *William J. McGuckin* to handle an augmented program of promotional activities.

GENERAL MILLS, INC., Mech. Div., announces that *Cledo Brunetti* has been appointed director of engineering, research and development; *John E. Barkley* becomes associate director of research and development; and *Carl L. Kober* is director in charge of systems engineering, research and development.

FISCHER & PORTER CO., Hatboro, Pa., announces appointment of *Jerry L. Magner* as application engineer.

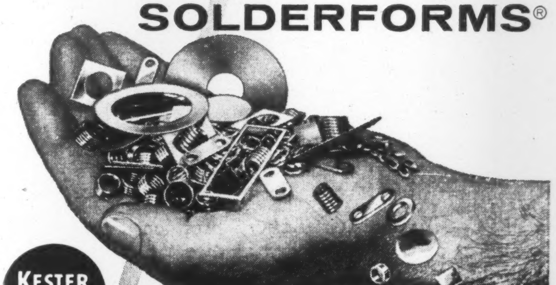
GE APPOINTS—*H. M. Sullivan,* laboratory manager, announces appointment of *John B. Russell* as manager of the Engineering Analysis Sub-Section of General Electric Company's Electronics Laboratory.

DuMONT PRESIDENT—*Dr. Allen B. Du Mont* announces election of *David T. Schultz* as president and director of Allen B. Du Mont Labs., Inc.

SIMPLEX—*Everett M. Jones,* executive vice president of Simplex Valve & Meter Co., Lancaster, Pa., announces appointment of *Joseph C. Holzwarth, Jr.,* as advertising manager.

TEXAS INSTRUMENTS—*J. E. Jonsson,* president of Texas Instruments, announces promotion of *Mark Shepherd, Jr.,* from assistant vice president to vice president in charge of Semiconductor Products Div.; *Walter F. Joyce,* vice president, announces appointment of *Major*

no limit on shape versatility... economy!
when you use **KESTER SOLDERFORMS®**



KESTER SOLDER

The right amount of solder every time when you use Kester Solderforms in your assembly operation. Produce better looking and more efficient products as well as greatly increase speed of manufacturing.

WHERE TO USE KESTER SOLDERFORMS

Capacitors • Switches • Resistors • Transformers Relays • TV and Radio Tuners • Gauges • Small Metal Assemblies and Controls . . . many, many others.

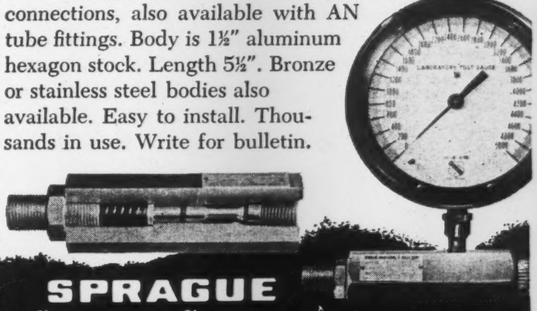
WRITE TODAY for free samples and complete information

KESTER SOLDER
COMPANY 4270 Wrightwood Avenue, Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

For more information circle 134 on inqiury card.

PROTECT
EXPENSIVE GAGES

SPRAGUE SHUT OFF VALVES automatically cut out gages and other pressure-sensitive instruments when fluid pressures go beyond their operating limits. Automatically open when pressure is again within approx. 80% of set cut-out points. Available for any pressure setting between 10 PSI. and 5000 PSI. Save valuable man hours. Eliminate opening and closing manually operated shut off valves. Supplied with standard pipe thread connections, also available with AN tube fittings. Body is 1½" aluminum hexagon stock. Length 5½". Bronze or stainless steel bodies also available. Easy to install. Thousands in use. Write for bulletin.



SPRAGUE
Engineering Corporation
1144 WEST 135TH STREET, GARDENA, CALIFORNIA

For more information circle 133 on inquiry card.

ENGINEERS
New Opportunities
with Republic Aviation

RESEARCH

Vibration Engineer

Two to five years aircraft vibration experience required. Shock and vibration theory and a practical knowledge of electromechanical shaker application as used in experimental research testing of complete airframes for flutter analyses and component investigation essential. Familiarity with usage of accessory electronic instrumentation equipment desired. Graduate with M.E. or A.E. degree preferred.

DYNAMICS

Senior Servo Dynamics Engineer

Responsible position in application of aircraft-servo dynamics to the analysis and testing of flight control systems of present and advanced fighter aircraft. Must be capable of planning and carrying out analytical and analog computer studies as well as laboratory tests of overall airframe-autopilot systems. Experience in servo-theory analytical methods is essential with application to aircraft or missile problems desirable.

Mechanical Systems Analysis

Senior Mechanical Engineer to study mechanical-pneumatic-hydraulic systems including analysis of systems, development of system equations, programming of equations on an electronic analog computer, planning and coordination of necessary physical tests and analysis of results. Prime requisites are strong basic understanding of mechanics and thermodynamics and the maturity to see difficult job through to completion. This work is completely new, challenging, and rewarding.

REPUBLIC'S NEW 2-FOLD RETIREMENT INCOME PLAN

PART 1. A basic Retirement Income paid in full by Republic.

PART 2. Optional: Engineer makes small monthly payment, company MORE THAN MATCHES contribution.

WHAT IT MEANS: Example: engineer starting Jan. 1, 1956 averaging $8,000 a year for 15 years, then retiring at 65, receives $225.80 per month, including Social Security, (HE WILL HAVE PAID IN ONLY $8.50 per month.)

OTHER REPUBLIC BENEFITS: All-Expense Paid Relocation Plan for engineers living outside New York and Long Island. Company-paid Life, Health & Accident insurance. Grants cover 2/3 cost of collegiate and graduate study.

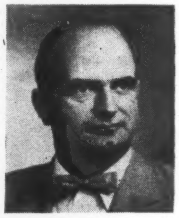
Please send complete resume, including details of your technical background, to:
Administration
Asst Chief Engineer
Mr. R. L. Bortner

REPUBLIC AVIATION
FARMINGDALE, LONG ISLAND, NEW YORK

PEOPLE—CONTINUED

General Charles F. Born, USAF, as director of Service Engineering of the Apparatus Div. of Texas Instruments.

C. F. Born
Texas Instruments



E. A. Keller
Panellit, Inc.

PANELLIT, INC., Skokie, Ill., announces appointment of *Dr. Ernest A. Keller* as director of research.

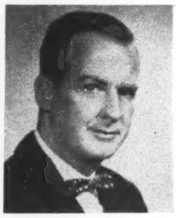
AMERICAN CHAIN & CABLE CO., INC., Bridgeport 2, Conn., announces appointment of *George W. Herman* as assistant plant manager.

J. B. REA—*W. V. Neisius* is Director of the newly created Computing Applications Department of the J. B. Rea Company of Santa Monica, California, announces *Dr. James B. Rea*, Pres.

IRC—The Board of Directors of International Resistance Co., announces election of *Harry A. Ehle* as executive vice-president and *Jesse Marsten* to senior vice president.

BECKMAN—*Dr. Arnold O. Beckman*, president, announces appointment of *Donald C. Duncan* as general manager, and *Thomas Allinson* as manager of Berkeley Div., Richmond, Calif.

Thomas Allinson



Donald C. Duncan

LIQUIDOMETER CORP., Long Island City, announces appointment of *Sanford Solarz* as advertising manager.

ELECTRICAL TESTING LABS., INC., announces appointment of *Rita Connolly*, to the staff of ETL's Infrared Laboratory.

CLEVITE—*William G. Laffer*, president, announces appointment of *Dr. S. J. Begun* as director of marketing for Clevite Corp.

LESLIE—*Russell W. Boettiger* has been appointed director of sales, *Alfred A. Fuhro* as director of manufacturing and *Sten Soderberg* as director of engineering for Leslie Co., Lyndhurst, N. J.

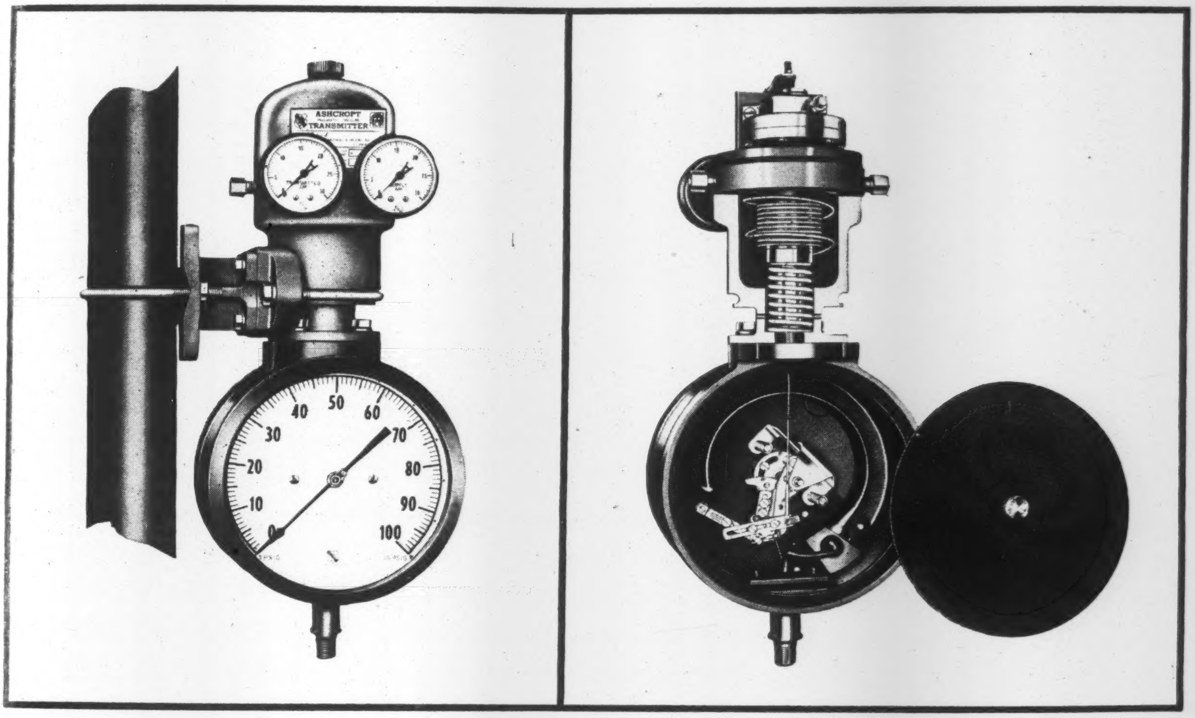
WHEELCO—*R. A. Schoenfeld*, sales manager of Wheelco Instruments Div., Barber-Colman Co., announces appointment of *John R. McCauley* to the Application Engineering staff at Rockford. Grant Edgel Co., Portland, Oreg., has been appointed representative for Wheelco.

BROOKS ROTAMETER CO., Lansdale, Pa., announces appointment of *Seymour Blechman* as executive vice president, responsible for the coordination and guidance of product improvement and expansion programs.

EDISON NEWS—*Henry G. Riter, III*, president, announces appointment of *Clyde B. Gardenier* as a vice president of Thomas A. Edison, Inc.

Designed to solve safety and service problems

...THE NEW ASHCROFT PNEUMATIC PRESSURE TRANSMITTER



This new Ashcroft Pneumatic Pressure Transmitter is particularly recommended to processing industries and power stations. It combines speed and accuracy with maximum protection and serviceability.

The new design features the 6″ indicating Ashcroft Maxisafe Duragauge, long known for dependable performance. It has an integrally-cast solid metal wall between dial and pressure sensitive element so that the transmitter can measure pressures up to *100,000 psi with complete safety* for personnel and equipment. If misapplication ruptures the Bourdon tube, the Teflon-coated back cover serves as a safety blowout relief.

Another outstanding design advantage is easy access to both gauge and transmitter sections. Simply remove the safety-relief back cover and both the gauge and transmitter can be calibrated. Yet a sealed housing makes the entire assembly weatherproof.

The transmitter operates on low-pressure air. No need for expensive high-pressure lines and fittings. Supply air pressure as low as 18-20 psi for 3 to 15 psi output provides especially advantageous operation where electrical wiring might be a hazard. Inflammable, poisonous or corrosive liquids or gases are confined close to their source, away from the central control point.

The Series 1250 Ashcroft Pneumatic Pressure Transmitter is available with pressure sensing elements in all standard pressure ranges and Bourdon tube materials. Installation of the transmitter is easy. Small diameter tubing may be used, and the pipe, stem, wall or flush mounts are interchangeable in the field. Get complete operational data and construction details. Write for Bulletin 340.

1850 ASHCROFT U.S.A.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the broad knowledge and thorough experience essential to satisfy every requirement of your Ashcroft Pneumatic Pressure Transmitter application. You get fast, economical service from his local stocks.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

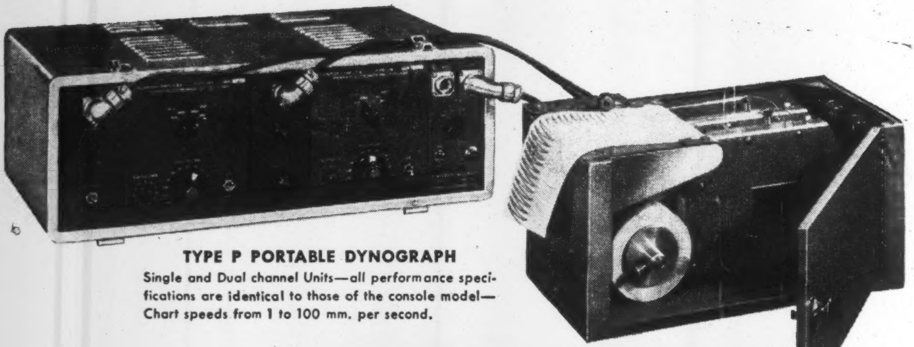
ASHCROFT GAUGES

MAXWELL MM MANNING & MOORE INC TRADE MARK

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

For more information circle **42** on inquiry card.



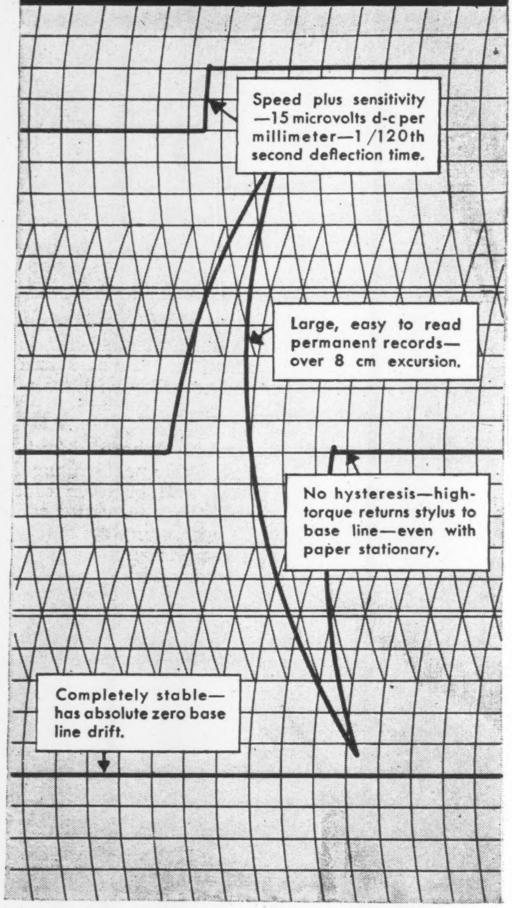
TYPE P PORTABLE DYNOGRAPH

Single and Dual channel Units—all performance specifications are identical to those of the console model—Chart speeds from 1 to 100 mm. per second.

TYPE M CONSOLE

Six channels—accommodates up to six Type 146 amplifiers with input couplers, uses roll or folded charts—eight chart speeds, 1 to 250 mm. per second.

OFFNER DYNOGRAPH RECORDERS



Speed plus sensitivity—15 microvolts d-c per millimeter—1/120th second deflection time.

Large, easy to read permanent records—over 8 cm excursion.

No hysteresis—high-torque returns stylus to base line—even with paper stationary.

Completely stable—has absolute zero base line drift.

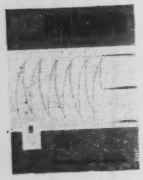
IF YOU COMPARE—YOU WILL SELECT THE OFFNER DYNOGRAPH!

Compare the direct writing oscillographs on the market today. If you do, you will select the Offner Dynograph because only the Offner Dynograph has these features:

15 microvolt per millimeter d-c sensitivity . . . Absolute *drift-free* stability . . . One amplifier for d-c amplification, resistance and reluctance gages . . . True differential input, isolated from ground . . . Rugged, low resistance movement.

No other direct writing oscillograph on the market has *any of these features!* The Offner Dynograph *has all these features and many more!*—because the Dynograph uses the exclusive patented Offner *chopper amplifier*. This amplifier must be distinguished from a chopper *stabilized* amplifier, which merely reduces, does not eliminate drift, and provides none of the other features of the Offner Dynograph.

If you want the widest versatility, highest accuracy, greatest reliability in direct writing high speed oscillographs—*compare them all!* You'll select the Offner Dynograph.

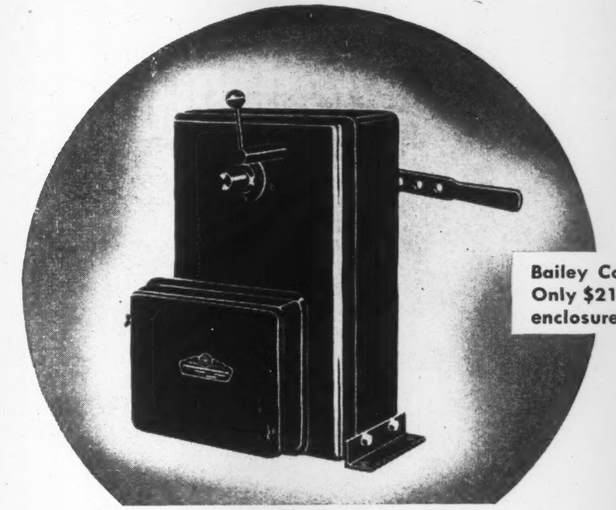


Write for your copy of Bulletin L-742. Get complete details and application information on both Portable and Console Models. Write for a demonstration by our Engineering Representatives in your area. Compare—and you will select the Offner Dynograph.

OFFNER ELECTRONICS INC.

5326 N. Kedzie Avenue, Chicago 25, U.S.A.

For more information circle 43 on inquiry card.



Bailey Control Drive, Type AC44P Model 200. Only $210.00 F.O.B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

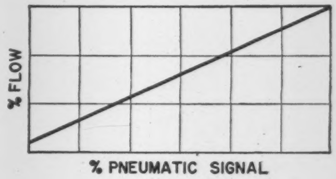
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

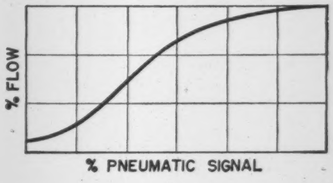
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



BAILEY
METER COMPANY
1041 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Process Plants

BAILEY METERS
Controls for
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO

FOR MORE INFORMATION
FILL OUT AND MAIL

☐ I am interested in Bailey Control Drives. Mail me Spec. P81-1.

☐ I am interested in Bailey Control Linkage. Mail me Spec. P81-5.

Name ______________________

Title & Company ______________________

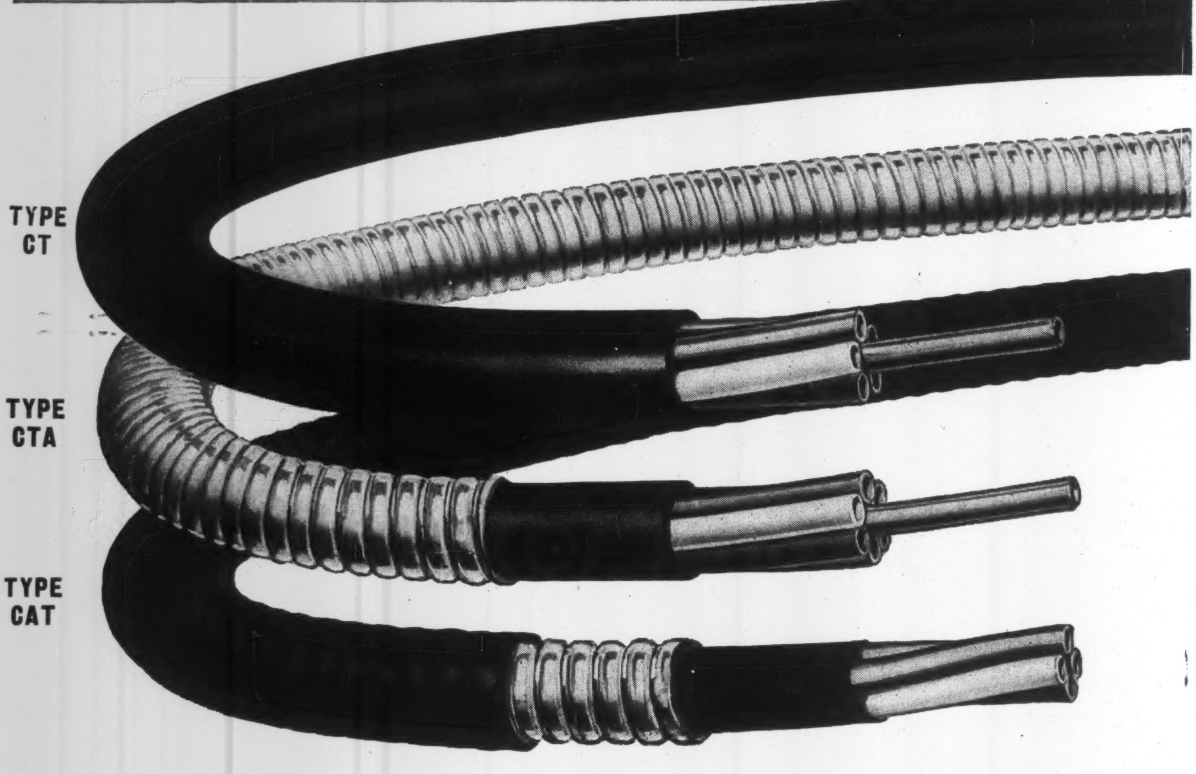
Street & Number ______________________

City & Zone ____________ State ________

For more information circle **40** on inquiry card.

CRESCENT ARMORED MULTITUBE

In 3 Corrosion Resistant Types



For Pneumatic and Hydraulic Instrument Controls

TYPE CT—In damp or corrosive locations where a moderate degree of mechanical protection to the tube is required, as in troughs or attached to building surfaces or supporting means, the construction shown in top view is recommended. It employs a tough corrosion-resistant thermoplastic sheath, resistant to water, acids, alkalies, oils, most chemicals, and is flame-retardant.

TYPE CTA—Where maximum mechanical protection is desired during or after installation, such as direct burial in concrete and pulling into conduit, an interlocked galvanized steel armor over the thermoplastic sheath, as shown in middle construction above, is recommended.

TYPE CAT—For maximum protection against corrosion and mechanical injury to the tubing, the thermoplastic sheath is applied over the flexible steel armor as shown in the bottom construction illustrated above.

These forms also provide the other advantages possessed by CRESCENT ARMORED MULTITUBE which include permanence, lower over-all cost and ease of installation.

CRESCENT ARMORED MULTITUBE consists of long length tubes **TWISTED TOGETHER** to permit bending without distortion. In each layer one tube is a bright blue color, affording a fast means of identification from both ends.

Available in long runs up to 1000 feet and up to 19 tubes of copper, aluminum or polyethylene tubing in size ¼″ O.D. This product is licensed under U.S. Patent 2,578,280.

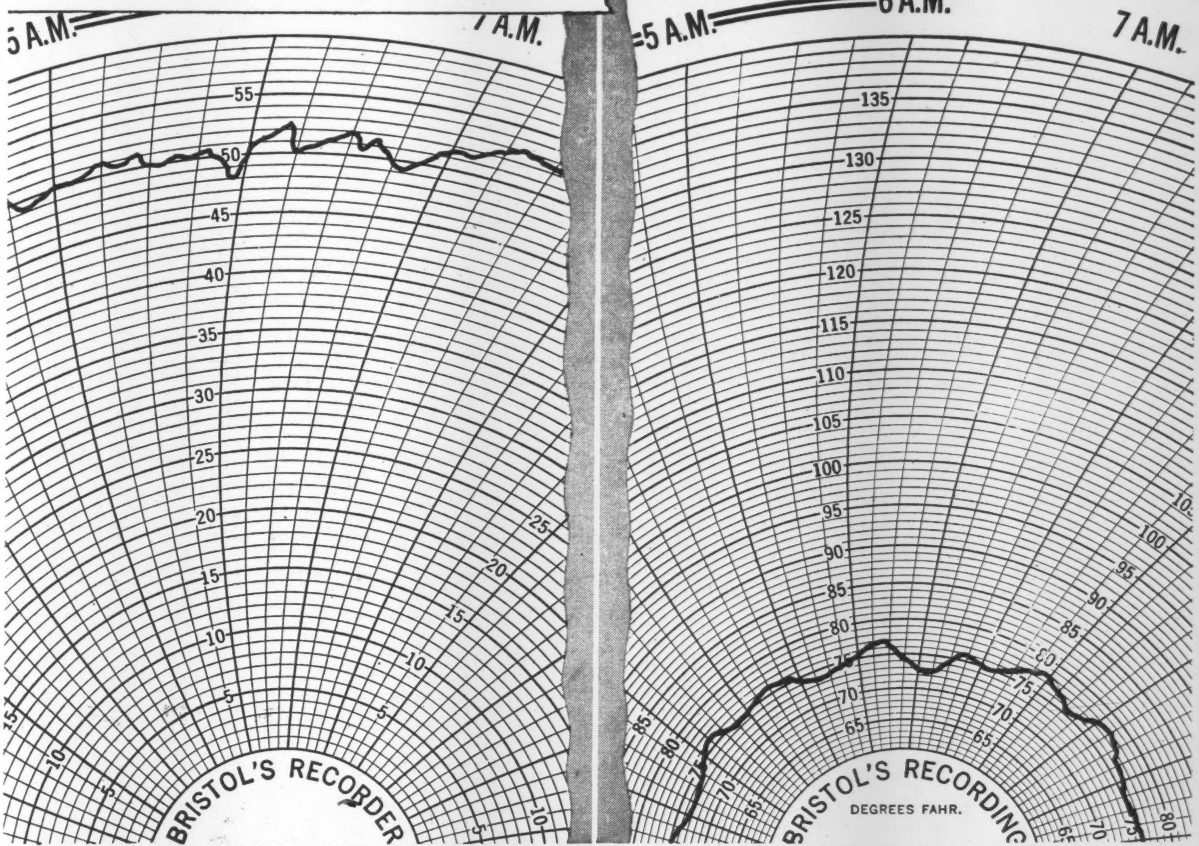
Send for bulletin giving complete information and engineering data.

CRESCENT INSULATED WIRE & CABLE CO.

OLDEN & TAYLOR AVES., TRENTON, N. J.

For more information circle **45** on inquiry card.

WHAT'S NEWS AT BRISTOL . . .



HIGH OR LOW CHART RECORDS are equally easy to read on a Bristol 2DL Recording Vapor-Pressure Actuated Thermometer . . . in comparison with the chart from a conventional increasing scale vapor-pressure recording thermometer shown above.

Bristol leads with linear scale vapor-pressure actuated recording thermometer

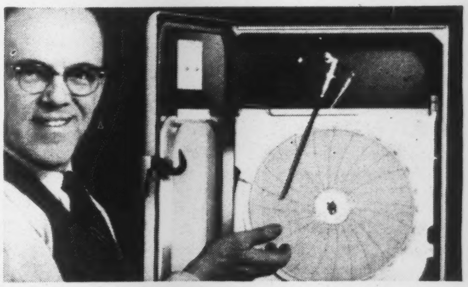
Tagged by instrument men as "the greatest advance in 25 years of recording thermometer building," Bristol's 2DL vapor-pressure actuated recording thermometer has a uniform linear scale that's equally easy to read at any point in its range.

It's another example of Bristol's "Human-Engineering" that means greater operating convenience, fewer errors, and easy visual interpolation.

MORE GOOD NEWS! In addition to this new high in readability throughout the entire measured range, Bristol has eliminated ambient temperature effects to boost the inherent accuracy of the recording thermometer still further.

GET ALL THE FACTS about these rugged precision instruments. Write today for free 48-page Bulletin T840 – it tells all about typical installations, ranges, charts, bulbs, and tubing. The Bristol Company, 113 Bristol Road, Waterbury 20, Conn.

5.20



HIGH-SPEED RESPONSE AND ACCURACY are key advantages of the new Bristol Vapor Pressure Recording Thermometers.

TRADE MARK
BRISTOL'S
REG US PAT OFFICE

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

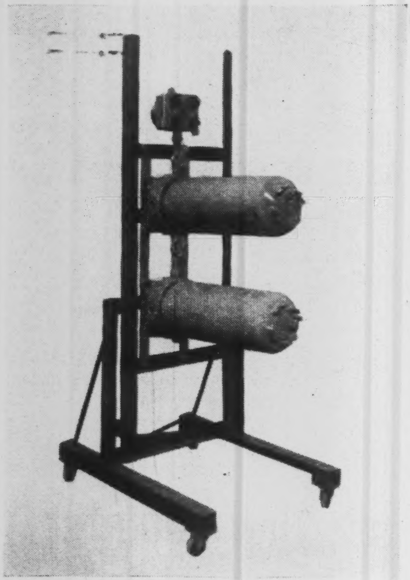
For more information circle **46** on inquiry card.

Analysis moves from Lab to Line with P-E Infrared Analyzers

It's getting to be old-fashioned to run a stream composition determination in the control laboratory. Chemical manufacturers can now hook analytical instruments directly into the process stream where they produce continuous and instantaneous data to guide the operation of the system.

Perkin-Elmer has designed a variety of infrared analyzers for this purpose: the TRI-NON* group of nondispersion analyzers, series A, B, C and D; and the BICHROMATOR* Analyzer operating on the dispersion principle. Each is designed to solve a particular class of continuous analytical problem and performs a continuous analysis of a single component in a liquid or gas stream. Within each series, variation of standard components permits tailoring to specific problems.

P-E application engineers can provide all the help you need in the selection of the proper equipment for any given analysis. Service facilities are nationwide.

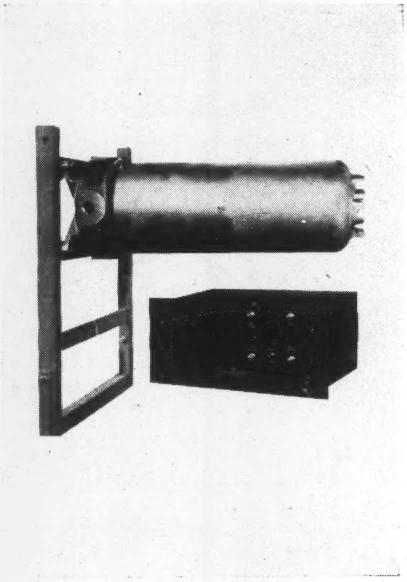


TRI-NON SERIES A

This is the deluxe series, offering maximum performance in all respects. These instruments are high in sensitivity, stability and discrimination, will operate under extreme ambient conditions, and are completely explosion proof. The pick-up section produces a shaft rotation which is proportional to the concentration of the gas of interest. This shaft rotation may appear, if desired, as an indicator at the instrument. Normally, it is transmitted through a slide wire potentiometer bridge circuit to the recorder by a 3 wire cable. This transmission system is not limited by a low voltage level and thus, there are no restrictions on the separation between the recorder and the analyzer.

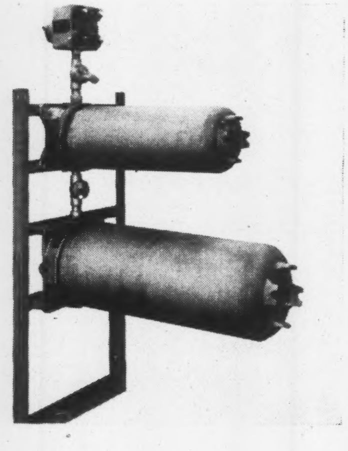
TRI-NON SERIES B

Explosionproof pick-up section with remotely located nonexplosionproof electronics and recorder. A multiwire cable over a maximum of approximately 500 ft. connects the two units. Performance, in the main, is equivalent to Series A instrument. Moderate price range. Usually this model involves a single servo loop incorporating the recorder.



TRI-NON SERIES C

Nonexplosionproofed. Pick-up section is nonexplosionproofed and connected by multiwire cable over a maximum of 500 ft. to the electronics section which is also nonexplosionproofed. Here again, this model involves a single servo loop incorporating the recorder. Somewhat less selective than other series but highly stable and adequate for many process stream analyses.



TRI-NON SERIES D

Nonexplosionproofed. All components — pick-up section, electronics and recorder — mounted in a cabinet with the pick-up section mechanically coupled to the recorder; has the same performance characteristics as Series C.

BICHROMATOR ANALYZER

Available explosionproofed and thermostatted. Automatic circuit testing and unitized construction simplify field servicing. Duplicates in a plant-designed instrument, the base line density method widely used in the infrared control laboratory.

THE **Perkin-Elmer** CORPORATION

830 Main Avenue, Norwalk, Connecticut

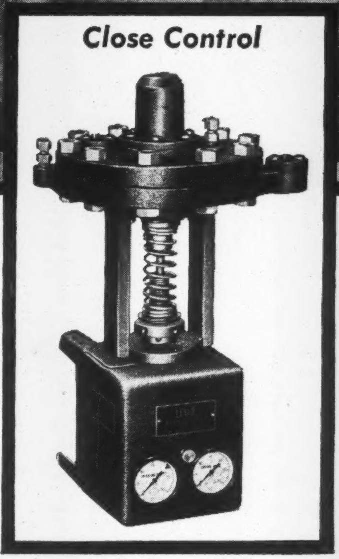
Teletype: Pasadena 7578 Teletype: Yonkers, N.Y. 3633

For more information circle **47** on inquiry card.

*TM The Perkin-Elmer Corporation

Here's the *pilot* with the *sense* to save *dollars*

FEEDWATER
HEATER
HOTWELL
CONTROL VALVE
FLOATLESS
LEVEL
PILOT



Leslie Type LA-2
Level Control Pilot

LESLIE FLOATLESS LEVEL CONTROL Pilots sense changes in liquid level that will help you maintain peak output. You save maintenance dollars, too — forget troublesome floats and cages (there aren't any).

With low resolution sensitivity (.1 of an inch change in level creates response), you are assured of smooth, throttling action and a closely held level.

You'll find Leslie Floatless Level Control Pilots in storage tank, boiler level and process vessel service — in fact, in any liquid level service where accuracy and dependability are important.

There are Leslie Pressure Control and Temperature Pilots with the sense to save dollars in pressure and temperature control stations, too. Your Leslie Engineer, listed under "Valves or Regulators" in your classified directory, will be glad to help you.

Send for Bulletin 5303 on Leslie Control Pilots

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 299 GRANT AVENUE, LYNDHURST, NEW JERSEY

3573

CONTROLLED QUALITY MEANS QUALITY CONTROLS

For more information circle **48** on inquiry card.

Why do so many Leading Industries Specify STANDARD PRECISION TIMING INSTRUMENTS for test cell, control room and laboratory?

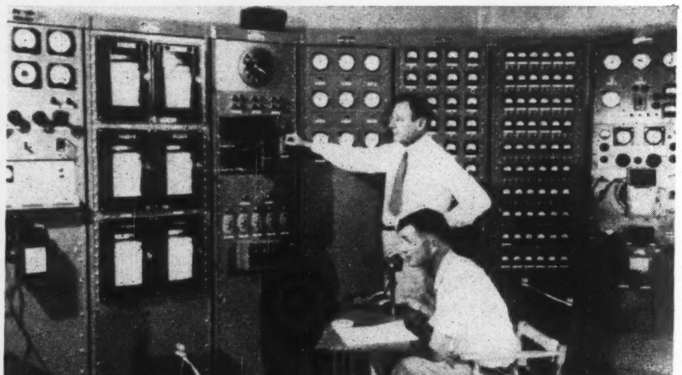
Whether you are counting revolutions per minute, or measuring time, you can rely on the split-second precision of Standard Timers and Chrono-Tachometers for accurate, reliable readings.

Engineer checks action of automatic transmission, with water simulating the flow of oil. His hand rests on a Standard timing instrument in the background.

Left: In this interesting test cell control room photograph a Standard Chrono-tachometer is located in the right foreground.

"Precision and accuracy, plus simple, rugged, trouble-free construction" is the policy which has guided us for over 70 years in the design and manufacture of instruments for indicating and measuring time.

With the increasingly rigid requirements for precision in every phase of research and development, this policy of the Standard Electric Time Company assumes greater importance than ever before . . . If yours is a problem of extremely close tolerances in the measurement of time or in the checking of R.P.M.'s . . . let our engineers help you.



The complex instrument panel in the control room of Control Point, Yucca Pass, Nevada Proving Grounds . . . The Precision Timers on the fourth and seventh sections are by Standard.

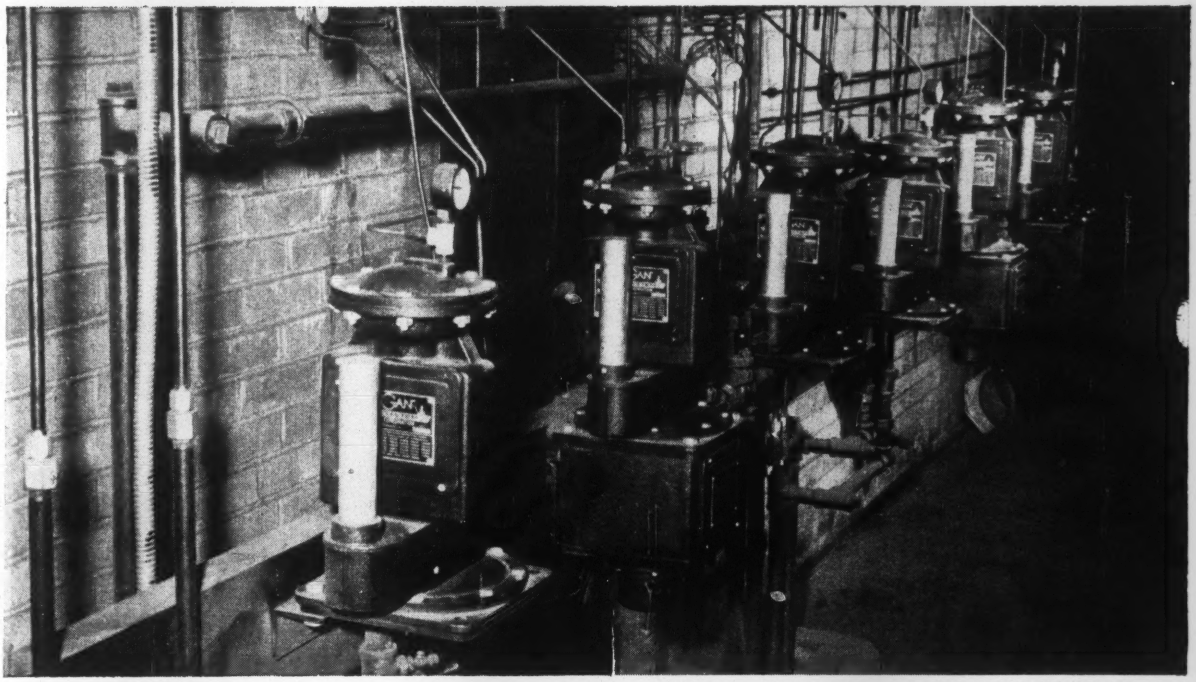
SINCE STANDARD 1884

The STANDARD ELECTRIC TIME CO.

93 Logan Street • Springfield 2, Massachusetts

PRECISION TIMERS • CHRONO-TACHOMETERS • LABORATORY PANELS • PIPELINE NETWORK ANALYZERS

For more information circle **31** on inquiry card.



Gas flow, air flow and coal flow regulators and transmitters at Weirton Boiler No. 5

Hagan automatic combustion controls at Weirton plant

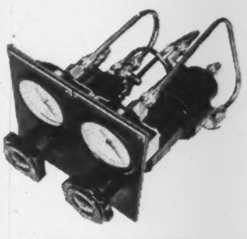
The Hagan systems on Boiler No. 5 at the Weirton Plant of the Weirton Steel Company include Automatic Combustion Control for triple-fuel firing, Three-Element Boiler Feedwater Control and Pressure Control Systems for blast furnace and coke oven gas. The remote manual switching employed for the regulation of the induced draft fan is an exclusive Hagan development* which adds to the over-all system efficiency by eliminating long transmission lines and speeding control response.

Hagan engineering skill has made possible many advances in fuel burning practices, and has resulted in system component designs which are versatile, accurate and extremely reliable.

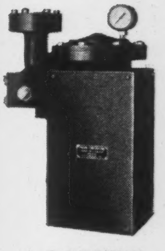
These Hagan instrumentation and control units are available as separate components. They are invaluable aids to the engineer who wishes to design solutions to his own control and metering problems.

For details on Hagan systems or components, see your Hagan engineer or write for descriptive bulletins.

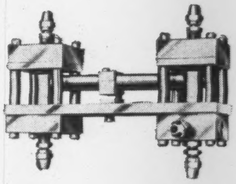
*U.S. Patent 2719535.



MANUAL-AUTOMATIC CONTROL STATION

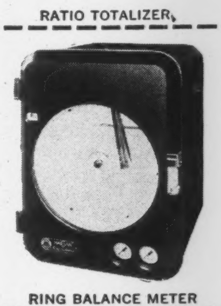


FLOW SIGNAL TRANSMITTER

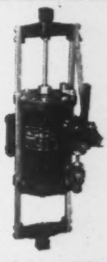


RATIO TOTALIZER

TYPE FRB LEVEL TRANSMITTER



RING BALANCE METER



POWER POSITIONER

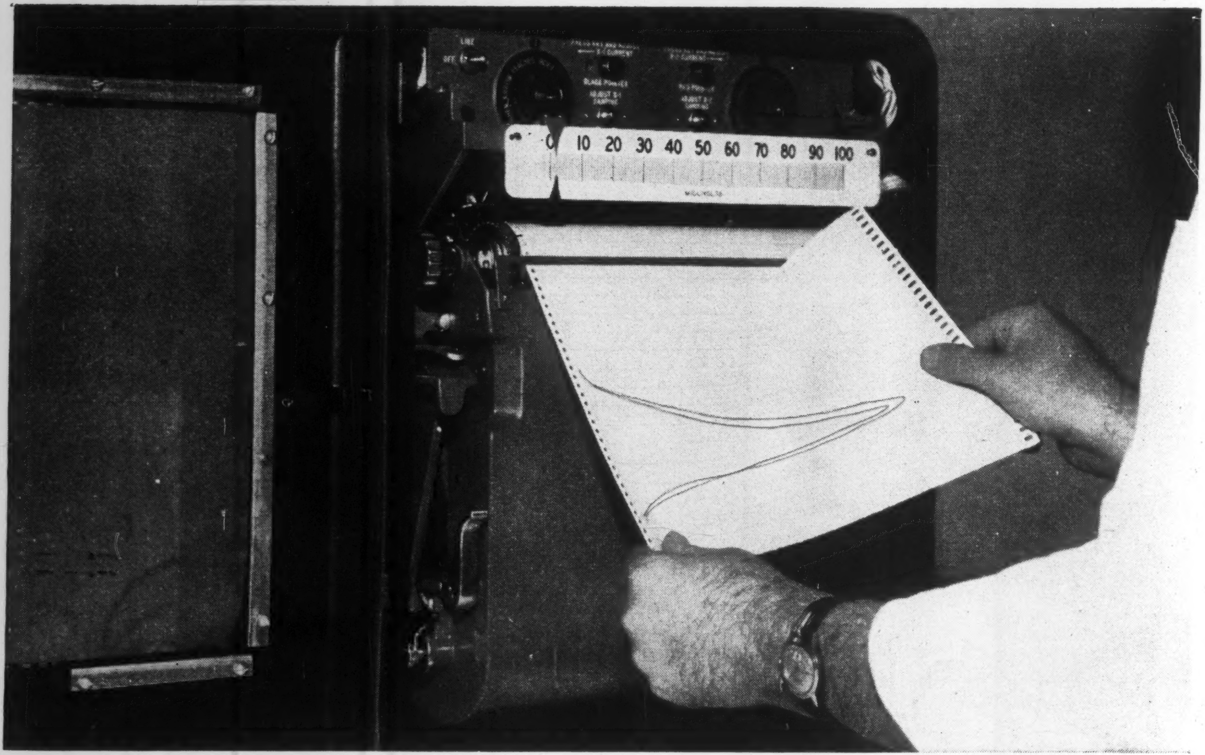
HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

Systems and components for: Process Control, Boiler Combustion Control, Metallurgical Furnace Control, Aeronautical Testing Facilities • Industrial Water Treatment • Chemical Water Conditioning

SUBSIDIARIES: CALGON, INC. • HALL LABORATORIES, INC.

For more information circle **49** on inquiry card.



Take your most accurate data

FROM A SPEEDOMAX® RECORDER

The confidence which scientists and engineers place in the accuracy of Speedomax Recorders is principally based upon six characteristics:

1. Powerful Dynamic Performance Quick-getaway balancing motor responds faithfully to input changes; velocity damping gives precise balancing, eliminates overshoot. The motor's six watts of amplifier-controlled balancing power is ample for operating practically any auxiliary control, transmitting and signaling functions.

2. Small Dead Band An input change as small as ±0.1% of range span . . . and often smaller . . . is followed precisely.

3. Electronic Stability A triple-filtered input detector prevents 60-cycle interference and pickup from affecting accuracy, even when such hash is as great as the range span of the recorder. You can locate the recorder near induction heaters, generators, motors, etc., with impunity.

4. Automatic Standardization Every 48 minutes, the instrument automatically checks its potentiometer measuring circuit against a standard cell. You can't forget or overlook this vital safeguard to accuracy.

5. Permanent Mechanical Alignment One straight-through, ball-bearing shaft carries pointer, pen, control cams and slidewire in precise, permanent alignment. Fewer moving parts mean less maintenance and longer life.

6. Permanent Calibration The null-balance measuring circuits use resistors and other components comparable to those in L&N's precise laboratory bridges and potentiometers.

Whether you're measuring temperature, pH, voltage, load or any other variable that gives a recordable electrical signal, Speedomax recorders are your surest safeguard to accurate data plotting. To choose from among the more than 2,300 Speedomax circuits, send all permissible information about your problem to our nearest Office, or to us at 4955 Stenton Ave., Philadelphia 44, Pa.

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instruments *automatic controls • furnaces*

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INSTRUMENTS and AUTOMATION Editorial

Automation's Impact On Education

Neil Hurley, S. J.

MUCH of the ink which has been spilled on the topic of automation has been primarily in reference to the technological and economic impact of what many choose to term the "second industrial revolution." However, despite the growing tide of literature and comment on the subject, comparatively little has been said about the effect of automation on man's intellectual development.

The most obvious impact of the new technology will be an acute demand for the engineering and scientific talent to meet the exacting requirements of a machine-dominated economy. With every advance in technology, history shows, a nest of further problems of even greater complexity are raised. To solve such problems will be the burden of tomorrow's generations. Consequently we can expect an intense *technical training* to grace the curricula of our schools and colleges. There should be a concomitant increase in the necessary leisure and time to be devoted to the *humanities.* Ironical as it may seem, automation bids fair to become an intellectual revolution as much as an industrial revolution.

Many fears have been expressed in the past concerning the greater mechanization of man's life. The displacement of human values and human activity has been poignantly expressed in such pieces as Karel Capek's "R.U.R." (ca. 1924), Charlie Chaplin's "Modern Times" (ca. 1935), Fritz Lang's "Metropolis," and René Clair's "A Nous La Liberté." The essence of industrial fatigue and dissatisfaction is not in repetition, but, rather, in divorcing a physical task from its corresponding psychic function. Thus a worker on the assembly-line, according to the famous study made by Charles Walker and Robert Guest —"The Man on the Assembly Line"—performs an operation which he can do successfully without focussing his higher faculties of intellect and will upon the task. Mentally the worker is absent—lost in his thoughts—while physically he is present.

However, industrial monotony has its counterpart in the academic world—namely, intellectual monotony: performing thought operations which can be mastered by habit with little more than marginal attention devoted to the task. Vannevar Bush has said in this connection: "Wherever logical processes of thought are employed—that is, wherever thought for a time runs along accepted grooves, there is an opportunity for the machine." Here is where automation's blessing lies with respect to man's intellectual life. It can reduce to a minimum the time ordinarily consumed in procuring information and data, in ordering it and processing it, in doing the thousand and one tasks which "run along accepted logical grooves."

Leisure has been the basis of the greatest periods of cultural flowering in the history of civilization. Witness the Periclean age in fifth-century Greece! At that time philosophy, drama, poetry, and art flourished due to the fact that a slave class liberated the citizenry from distracting, routine chores so that they might devote themselves wholeheartedly to the Muses. Similarly, a great burgeoning in the arts and humanities could attend the age of automation. However, instead of creating an inspired edifice of culture on the foundation of human slavery as the ancient Greeks did, an automated society could dispose its citizens for leisure and humanistic training by means of the slavery of machines.

The leisure which automation promises can enrich tomorrow's scholars. The very word "scholarship" is derived from a Greek word—*σκωλαξειν*—meaning to have leisure. The word "school" has the same etymology. With greater leisure in an automated age it is to be hoped that specialists will have a sufficient margin of time to devote to other disciplines.

Impact in Research

A contrast between the research student of today and that of tomorrow will indicate where this additional time will be saved. Today's student must consult numerous periodicals and reference works; he must collate the disparate sources from periodical indices; translate important manuscripts written in foreign tongues; visit special libraries; order microfilm copies from abroad; wait for inter-library loans; travel to interview experts and famous persons; compute statistical data and mathematical formulae of a rote nature. All these tasks are basic to any serious program of research, and entail the expenditure of large amounts of energy, time and, often, money.

Tomorrow's researcher will have a comparative breeze of it by virtue of the automated library and research facilities which will be at hand. Instead of searching index cards and files and writing out request cards, the automated scholar will merely push a button using the proper code to designate the desired book. In a matter of seconds the information will be furnished—not in bulky volume form, but as a magnetized or perforated tape roll ready to be inserted into an electronic viewer for purposes of projection on a handy screen. So compact will such tapes be that libraries will be able to store an unbelievable amount of information within small areas.

Moreover, foreign language books will present no problems inasmuch as electronic translators will transfer the semantic content of one pre-coded tape into symbols which will have meaning to the reader. This achievement, rendered possible by an automatic device, reveals the amazing possibilities of automation in pushing back the frontiers of learning.

As automation liberates men from the wearying yoke of mass-production techniques, as assembly-line techniques are consigned to electronic devices and instrumentation controls, men, in turn, will be charged with the more dignified and challenging task of coordinating machines and "feedback controls" into successful in-line productive processes. So too in the new phase of "Operations Research," men are being delegated with the authority to perform the specifically human operations of deciding what information goes into computers and electronic mechanisms and what is to be done with the processed data which issues therefrom. In our schools and colleges, students will learn in a fraction of time facts and principles which their fathers had to learn with greater difficulty over longer periods of time. The one serious problem which will arise is that of "communications saturation"— i.e., how much knowledge can man singly and collectively assimilate? As yet we have not plombed the depths of man's intellectual capacity. The age of automation will test this capacity to the fullest when it allows men to concentrate almost wholly on analysis and theorizing.

The impact of automation on cultural habits has been foreshadowed somewhat by the current "do-it-yourself" fad; the American people are expressing their creative instincts in the additional leisure which our higher standard of living has provided. If automation lives up to all of its advance notices then leisure time should grow proportionately. Already there are rumors of a possible 30 hour week; the Twentieth Century Fund foresees a thirty-eight hour week by 1960. This is a startling contrast with the factory work week of 78 hours which prevailed in America in 1840!

It will be the responsibility of modern educators to prepare for the happy eventuality of shorter working hours. Man now has the opportunity to discover more of his past, of the great intellectual heritage which has been bequeathed to him. In order for greater human fulfillment to be realized in an automatic society people must be trained to use their free time judiciously; this presupposes habits of study and contemplation; it demands as a foundation an acquaintance with poetry, literature, drama, history and the fine arts in general. The odious effects of a continual man-machine relationship can only be counter-balanced by a preoccupation, outside of working hours, with organic activities such as vis-a-vis contacts with nature, the art of stimulating conversation, creative past-times, a penchant for the arts, crafts, reading, travelling. A higher standard of material living finds its only justification in a higher standard of fully human living. Otherwise there is an imminent danger that, in a mass-production economy producing standardized end-items, human personalities will become as stereotyped as the fruits of an assembly-line. This unquestionably is the most serious challenge facing educators in an automated society and those who determine policy in the mass-communication fields.

Three avenues of approach are open to the worker who finds that his job in an automated society leaves him an abundance of free time. He can be totally unprepared for the luxury of leisure and, in order to dissipate the ennui which results, may pursue unwholesome and passive forms of recreation. In other words restlessness will provoke him "to kill time," usually in a sensational manner. Or the worker, unaccustomed to being idle, can seek a second job; the phenomenon of the "dual job" is quite common even today. This will be the choice of those who are industrious and, because of a desire to improve economically, are willing to trade their leisure for more employment. The third possibility is the worker who, schooled to contemplation, intellectual activity and creative pasttimes, elects to develop the latent resources of his personality in organic, humanistic undertakings.

Specialization and technology, as exigencies of an automated society, need not necessarily condemn man to solitary confinement within the narrow canyons of a single discipline, nor the exclusive communion with the mechanical and the synthetic. With greater time for intellectual assimilation and reflection, and with increasing opportunities for personality development, the humanities should find an honored place, together with the sciences, in highly technological societies. Both must flourish side by side if automation is to be man's servant and not his master. With a proper correlation of the two in America's educational programs, the age of automation should succeed in placing on the lips of millions the ancient brag of Terence: "Homo sum: nihil humanum a me alienum puto." ("I am a man: I deem nothing human foreign to me.")

Dear D.R.*

We thought you might like Rev. Hurley's inspirational ideas about automation and culture—particularly after your strong reaction to our August editorial in which we pointed out that our national cultural rate of change is slightly negative at the moment.

We want to call your attention to the several new features in this issue—particularly Panhandle Pete, People, Plants, and Inquiries. Like them?

Please take time to read the article on Linear Programming in our Digital Automation Series. (We say this about this series every month—and we mean it.) Linear programming is becoming more important every day in many different fields. There will never be an excuse for you to say that you don't know the fundamentals of linear programming—not after you read this.

Also of special significance is Richmond Voil's history of orifice metering, Chet Beard's new series on valves (which begins in this issue), and the article by Karen and Loveman on solution of large problems at Project Cyclone. This latter article gives nice perspective about equipments, checks, and practicality of really big problems—and teaches a lot about the entire field of analog computers.

Best part of our month is hearing from you—so if you want to keep your editorial staff happy, drop us a line of comment.

Cordially,
Milt and The Editors

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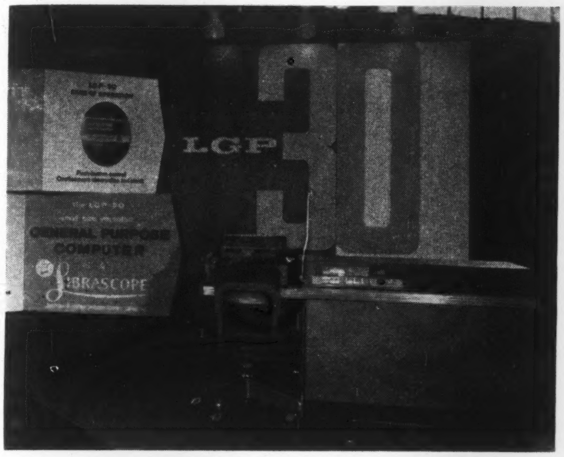
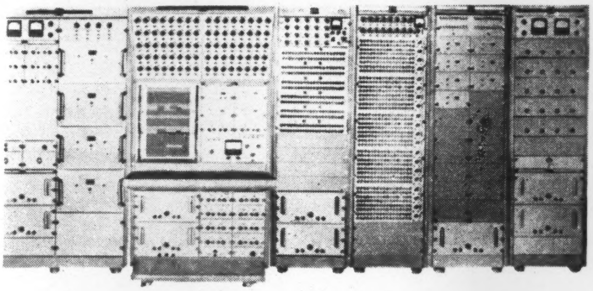
*Dear Reader

Pic Review of Second Automation Exposition

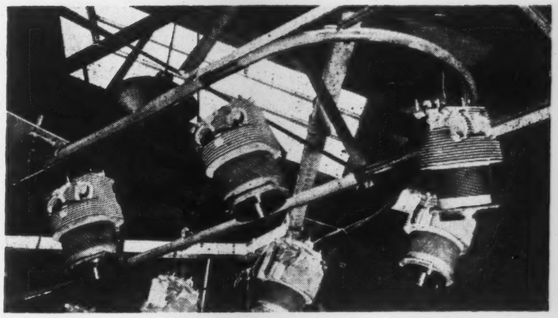
The Second International Automation Exposition, Chicago, Nov. 14-17, 1955 was the first to assemble the many aspects of "automation" under one roof—as will be seen from the following pictorial review of exhibited products. Here, for the first time, the production executive found the equipments for automation of plants, factories, offices *and* laboratories.



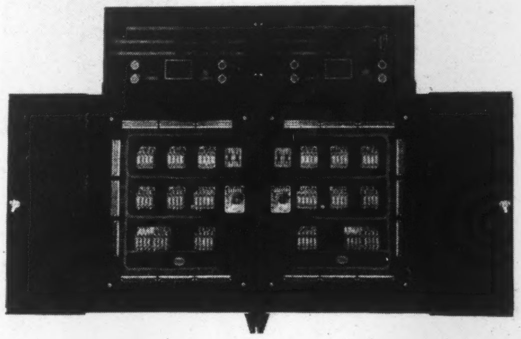
The Librascope LGP-30 low-cost digital computer was unveiled at the Automation Exposition. In addition to the 11,000 show registrants who saw the new computer, more than 200 engineers received personalized clinic instruction on it. Other digital equipments were displayed by Bendix, Clevite, Computer Control, IBM, Logistics Research, Metrotype, National Cash Register, North American Aviation, J. B. Rea, Teleregister, Victor Adding Machine, and Western Union.



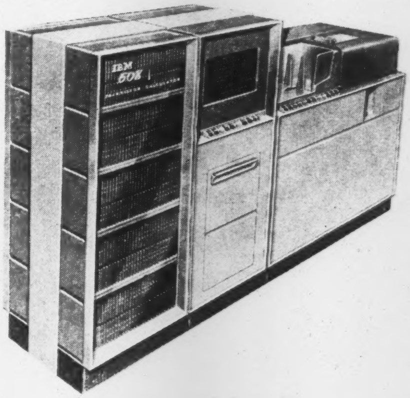
Typical of the analog computers displayed was this Electronic Associates 16-31R expanded system. Other analog computers were exhibited by Goodyear Aircraft and Berkeley-Beckman.



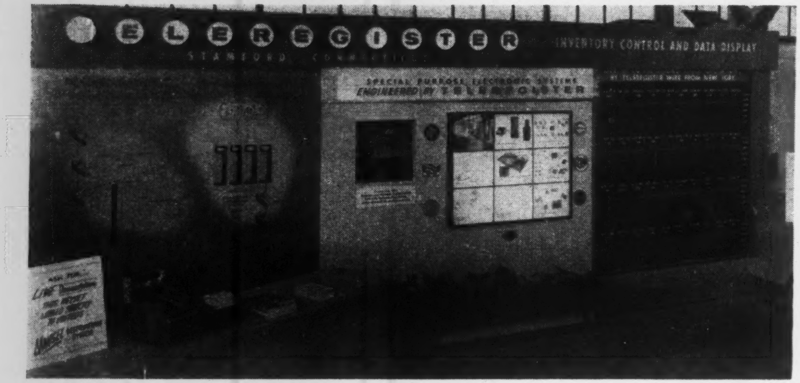
Materials handling equipments for automation were an integral part of the Automation Exposition, and were exhibited by Chainveyor Corp. (above), Mechanical Handling Systems, and Jervis B. Webb Co.



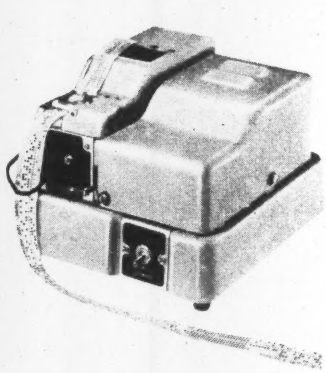
This drying-oven control panel (of Industrial Control Panel Co.) was typical of the packaged control centers exhibited by Zenith Electric, Industrial Timer, Counter and Control, etc.



The IBM Type 608 Transistor Calculator, the first commercially available transistorized machine, aroused great interest—and was also included in the Computer Clinic.

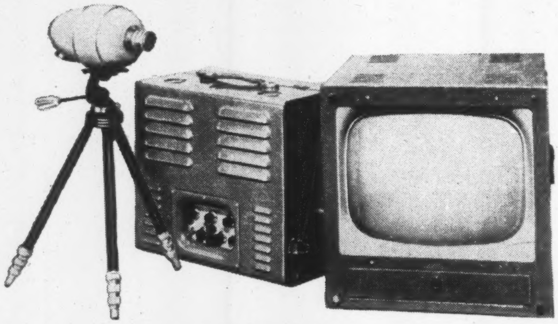

TELEREGISTER
STANFORD CONNECTICUT
INVENTORY CONTROL AND DATA DISPLAY
SPECIAL PURPOSE ELECTRONIC SYSTEMS ENGINEERED BY TELEREGISTER

All six computer clinic sessions of the Teleregister Corporation were sold out—and the lucky registrants learned the theory and operation of modern inventory control and data reduction and display equipments.

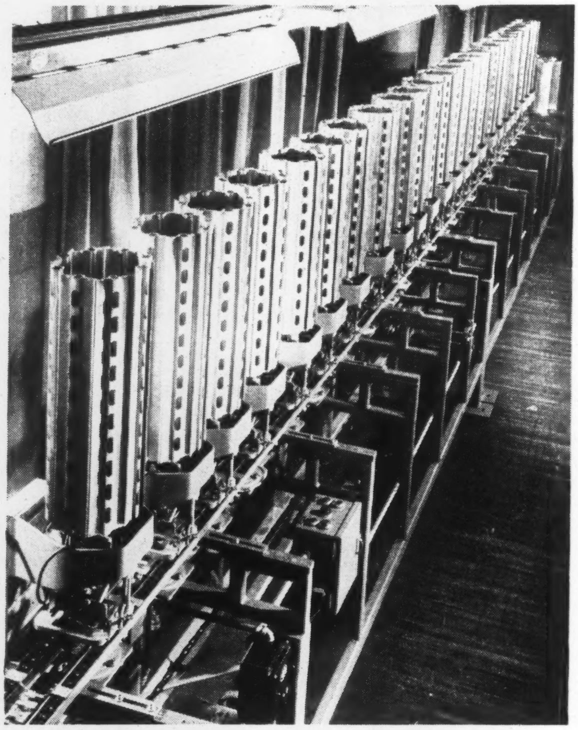


Tape transmitter of Kleinscmidt was one of many exhibits showing uses of teleprinting systems.

The Russians visiting the Automation Exposition stopped to examine this General Precision Laboratory industrial-institutional (GPL-iiTV) television system in detail. Other ITV systems were exhibited by DuMont and Dage Television.



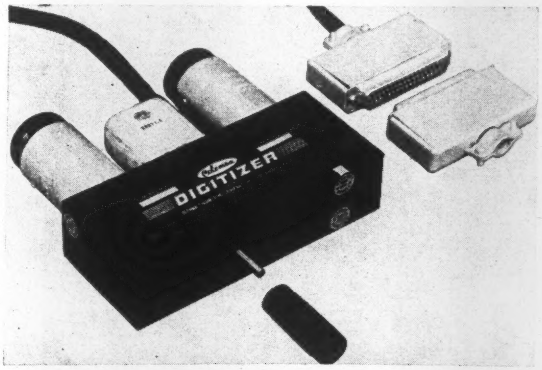
Automatic data logging was one of the many highlights of the Automation Exposition. This logger was exhibited by Fischer & Porter. Others for data logging of process variables were exhibited by Metrotype and Panellit.



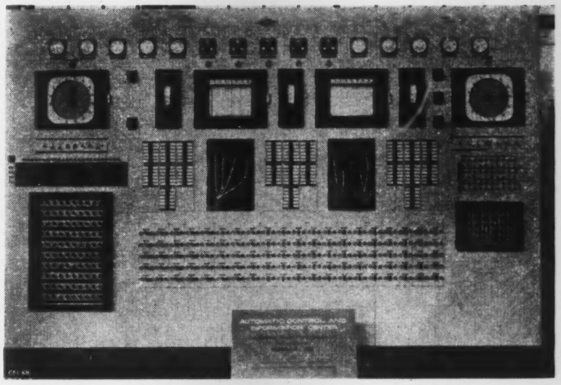
This Autofab assembly system of the Mechanical Div. of General Mills was one of many showing automatic production of circuit assemblies, including the Protomaka of Printed Electronics and the Automatic Wiring Machine of Clevite.

WHEELCO
0
400
800
1200
1600

Process Instrumentation: This new "400" Series Capacitrol of Wheelco was one of many important process controllers, including the contact meters of Assembly Products, the process refractometers of Barnes Engineering, the automatic weighing machines of Brinkmann, the digital pressure systems of Byron-Jackson, the process panels of DuBois Engineering, the pyrometers and thermocouples of Elematic, the pyrometers of Simpson Electric, the F&P pressure systems, electronic flowmeters and Veriflow and Condu-Therm units of The Hays Corp., the valves of Hoke and Republic Mfg., ultrasonic flowmeter of Maxson, the process control centers of Panellit, the process monitors of Scam, the weighing systems of Streeter-Amet, a new line of limit detectors by Stromberg-Carlson, the process instruments of United Electric, the pressure and gas analysis equipment of Uehling, and the temperature controllers of West.



Analog-to-digital converters (and vice versa) received a great play at the show. This is the Coleman Digitizer; also displayed were the F&P Digi-Coder, the Giannini Encoder, Hycon digital voltmeters, IDL Digitalizers, Metrotype data reducers, Panelog Information Systems, Vanguard Data Reduction, and Victor Adding Machine Data Systems. The result—another highlight of the Automation Exposition.



Panellit control and information center displayed was working model on way to its plant.

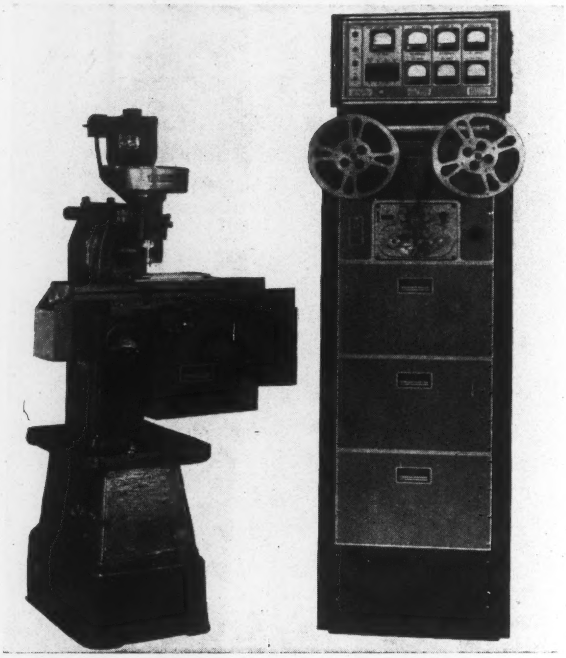
The Potter Magnistor vied with the new Ferristor circuitry of Berkeley-Beckman and the EPSCO magnetic storage elements for the title of chief solid-state attraction.

Potter
MAGNIST
INSTRUMENT COMPANY

PB
Potter & Brumfield
most engineers choose
Potter & Brumfield Relays

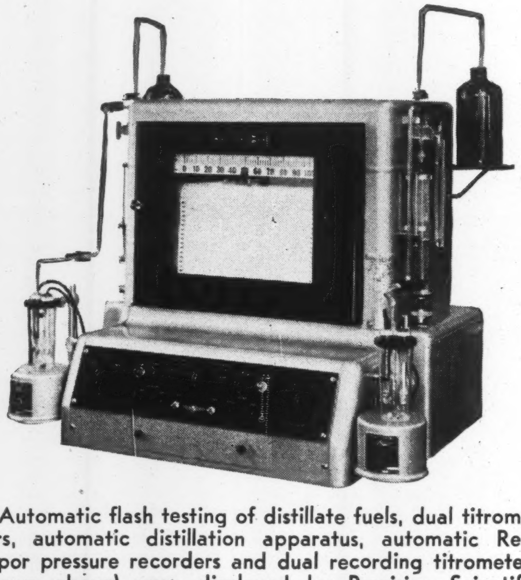
Relays of every type and complexion emerged at the Automation Exposition as a basic automation component. This exhibit shows the many types displayed by Potter & Brumfield—add to these the displays of Advance Electric, AGA, Automatic Electric, C. P. Clare, Comar, Electro-Snap, E-T-A, Guardian, Industrial Timer, Instrument Development Labs, Kellogg, Kulka, Ledex, Magnecraft, Micro Switch, North Electric, Spencer and Zenith—and the result was another highlight of the Automation Exposition—RELAYS.

More than 200 students received clinic sessions on this G-15A General-purpose Digital Computer of Bendix at the Automation Exposition.

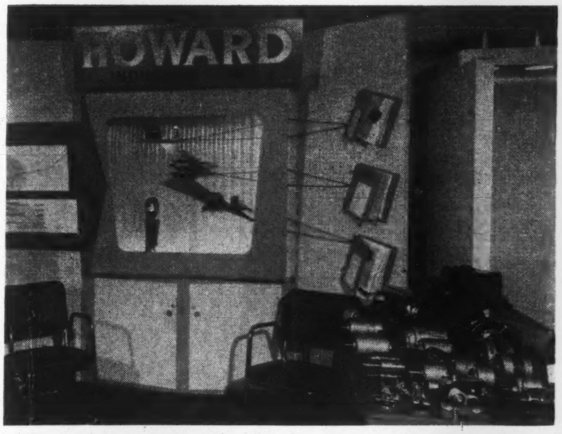


This magnetic programmer for power machine tools was exhibited by Automation Corp. of America, which displayed its complete ACA programming console. Other machine-tool controllers were exhibited by The Austin Co., A-V Mfg., Automation Engineering Lab, Brush, and Farrand Optical.

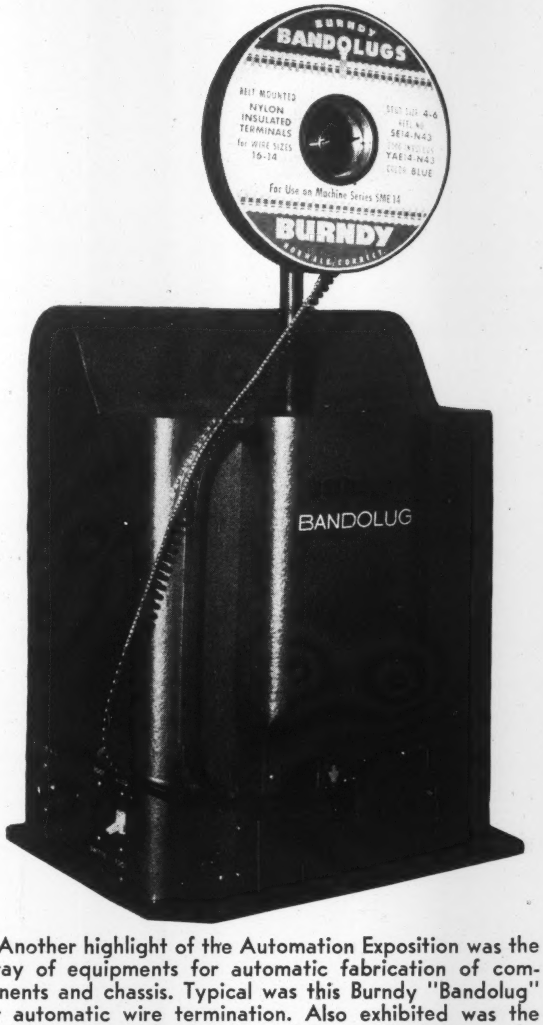
The clinic sessions on this exhibited tapeDRUM of Clevite-Brush brought out the fascinating possibilities for automatic control of data, records, inventories, bank accounts, etc.



Automatic flash testing of distillate fuels, dual titrometers, automatic distillation apparatus, automatic Reid vapor pressure recorders and dual recording titrometers (shown above) were displayed by Precision Scientific Company.



The Howard Industries Display featured a large line of fractional-hp motors—universal, shaded pole, induction, etc.

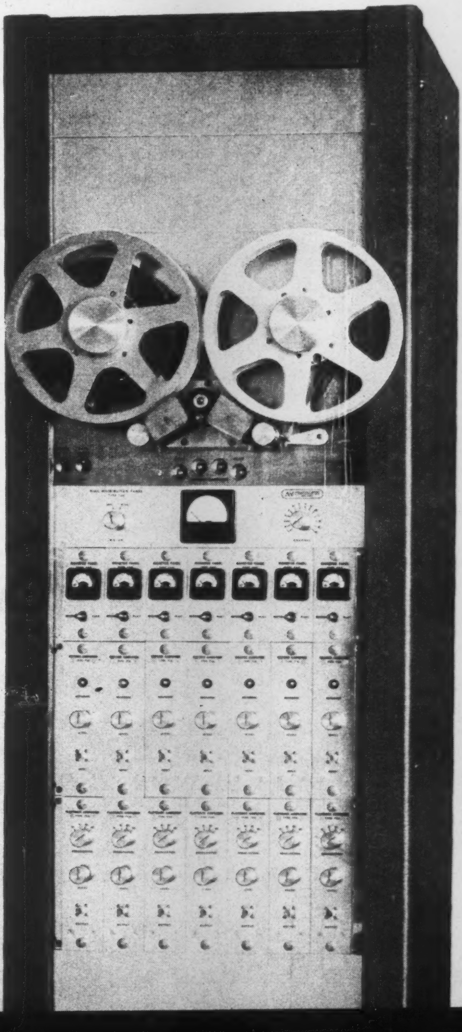

BURNDY
BANDOLUGS
BELT MOUNTED
NYLON
INSULATED
TERMINALS
for WIRE SIZES
16-14
STUD SIZE 4-6
SE14-N43
YAE14-N43
BLUE
For Use on Machine Series SME 14
BURNDY
NORWALK, CONNECT.
BANDOLUG

Another highlight of the Automation Exposition was the array of equipments for automatic fabrication of components and chassis. Typical was this Burndy "Bandolug" for automatic wire termination. Also exhibited was the lead-formers and lead-cutters of Design Tool Corp., the automatic wiring machines of Clevite, the liquid resin dispenser of Eastern Precision Resistor, the cable vulcanizers of Joy, the etched-circuit equipment (Protomaka) of Printed Electronics, etc.

Elematic EQUIPMENT CORP.
INDICATING & RECORDING

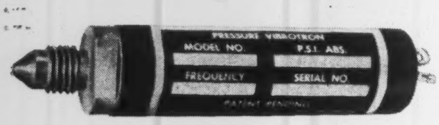
The Elematic display featured pyrometers and thermocouples.

Tape handlers are an integral part of modern data handling and reduction. Their complete representation at the Automation Exposition is shown by the following listing of exhibits of magnetic recording and punched-paper-type data-handling exhibits: Austin, Automation Corp., A-V (shown below), Brush, Clary, Davies Labs, Int'l Standard (IT&T), Kleinschmidt, Nat'l Cash Register, North American Aviation, Potter, J. B. Rea, Soroban, Teleregister, IBM, and Victor Adding Machine—PLUS other drum-type data recorders.

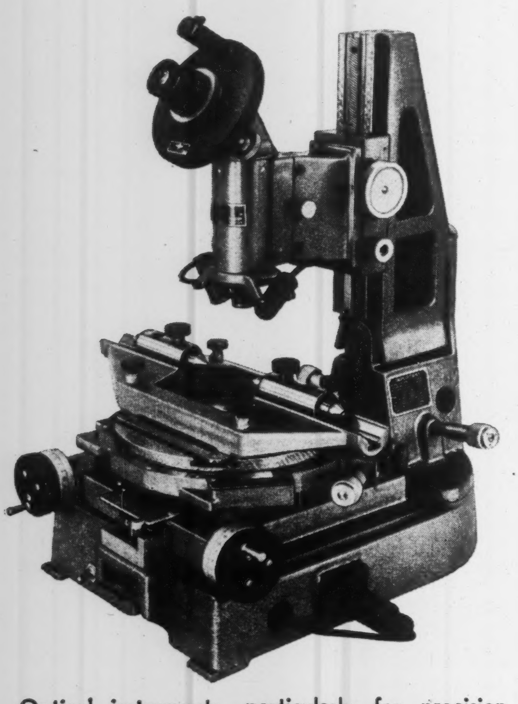


FARRAND ... AL CO. INC.
INDUCTOSYN CONTROL SYSTEMS

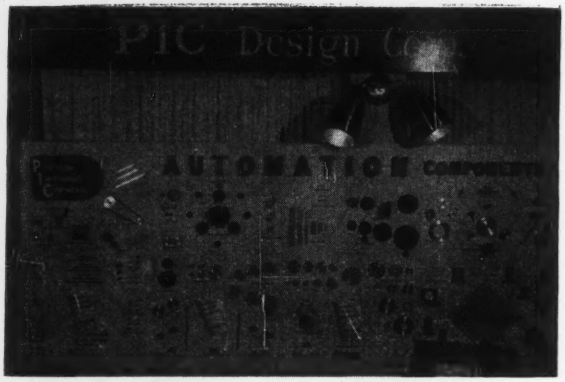
The Farrand Optical machine-tool controller, shown here on display at the Automation Exposition, is based on the Inductosyn data transmitter and servo.


PRESSURE VIBROTRON
MODEL NO.
P.S.I. ABS.
FREQUENCY
SERIAL NO.
PATENT PENDING

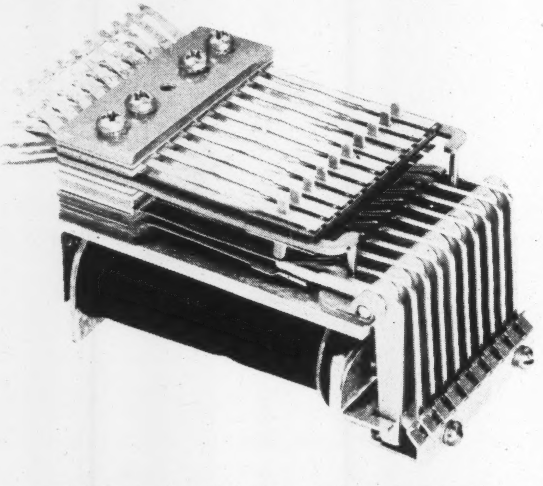
This pressure-sensitive pickup with digital output was one of many transducers exhibited at the Automation Exposition.



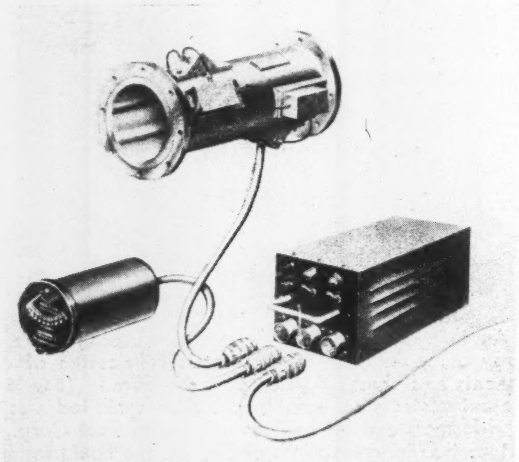
Optical instruments, particularly for precision linear and angular measurements—were also well represented at the Automation Exposition. Above is the exhibited toolmaker's microscope of Gaertner Scientific. Swiss photo equipment was exhibited by Karl Heitz; electronic autocollimators by Optronics.


PIC Design Co
AUTOMATION COMPONENTS

The precision mechanical component was also well represented at the Automation Exposition. This exhibit of PIC Design Corporation offered a large line of stock parts to the systems designer. Other precision gears, speed reducers, etc., were displayed by Bowmar and Dynamic Gear Co.

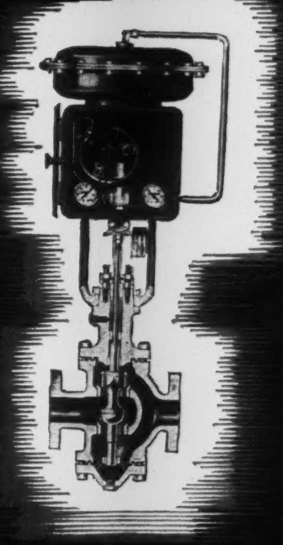


An exhibited relay that attracted much attention was this magnetic impulse counter of Kellogg—a relay with 10 armatures but only one solenoid. It responds sequentially to a series of pulses.



The Maxson ultrasonic flowmeter attracted much attention at the Automation Exposition.

Circle 51 on inquiry card →



FISHER® WIZARD – – – *UNIVERSALLY ACCEPTED AS THE WORK HORSE ON PRESSURE CONTROL JOBS*

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

Instrument Manufacturing In 1956

Everything in our society is growing, including our field of instrumentation. Nothing can remain static. Things must become bigger and better, more organized and efficient.

It is for this basic reason that the magazine INSTRUMENT MANUFACTURING becomes a part of INSTRUMENTS & AUTOMATION, beginning in this issue. All the features previously published in IM—industry news, new products, inquiries, etc.,— will now appear monthly in one magazine which thereby will contain a comprehensive over-all view of the entire instrument and automatic control industry.

One important result to you, the individual reader, is that the number of publications that you must read in order to keep abreast of our dynamic field is reduced by one, at least.

Another important service is that every aspect of our field will be within the pages of a single established publication, the acknowledged leader of the field.

Both of these services will redound to the benefit of our field, instrument user and manufacturer alike.

—MHA

ASCO

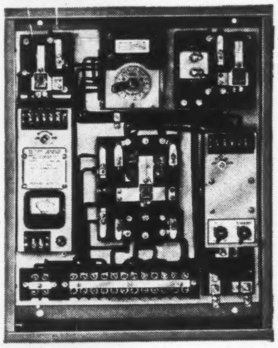
the *one* source for ELECTROMAGNETIC CONTROLS that offers engineers complete design flexibility

When designing equipment requiring electromagnetic controls, many engineers have found it saves them money if they first talk with an ASCO engineer before specifying solenoids, contactors or relays. His advice will help you cut initial cost, improve your final product and simplify automatic control.

Most important, the ASCO representative can recommend not only standard and special purpose controls, but can also offer the development services of ASCO, the one source that offers engineers complete design flexibility. His knowledge will allow your imagination free rein—unshackle you from the limits of designing with only conventional controls in mind.

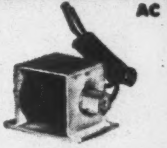
Why not have an ASCO engineer call . . . or write outlining your problem. We shall be happy to assist you.

COMPLETE CONTROL PANELS



ASCO engineered and manufactured panels are provided by combining ASCO controls with purchased equipment as needed.

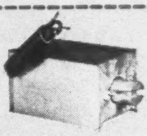
AC SOLENOIDS



104S1
Stroke up to ¾"

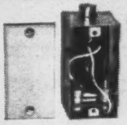
104S4
Stroke up to 1⅜"

DC SOLENOIDS



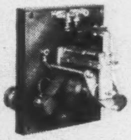
106S4
Stroke up to 1"

106S14
High Pull
Stroke up to 1"

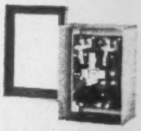


106S76
Fuel throttle control.
Stroke up to 1¾"

SPECIAL PURPOSE RELAYS



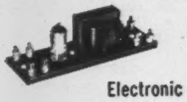
Reverse Current



Brake Motor Time Delay

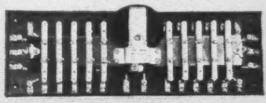
Close Differential

Coil-less

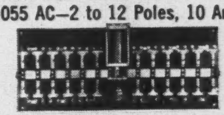


Electronic

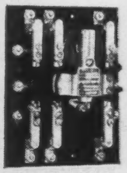
MAGNETICALLY HELD RELAYS



1055 AC—2 to 12 Poles, 10 Amp.

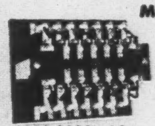


1058 DC—2 to 12 Poles, 10 Amp.

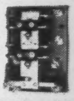


1054 AC—
1 to 3 Poles,
25 Amp.

MECHANICALLY HELD RELAYS



1256-168S—AC
2 to 12 Poles, 10 Amp.

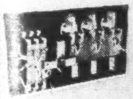


1255—AC-DC
1 to 5 Poles, 25 Amp.

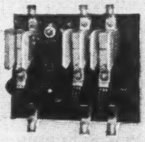
1255-166S—AC
1 to 6 Poles, 25 Amp.

WRITE US FOR MORE DETAILED INFORMATION ON ASCO ELECTROMAGNETIC CONTROL EQUIPMENT

CONTACTORS

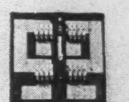


ontactors for computers

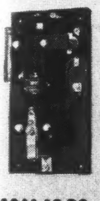


1035 AC,
Normally Open

1045 AC-DC,
Double Throw

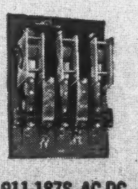


1025-111S DC,
Low Voltage,
High Amperage



1044 AC-DC,
ormally Closed

1025-131S DC,
Field Discharge



911-187S, AC-DC,
Feeder Switches

AC-DC,
Marine Duty

ASCO®
Automatic Transfer Switches
Electromagnetic Controls
Solenoid Valves
Automatic Switch Co.
385T Lakeside Avenue, Orange, New Jersey

For more information circle **52** on inquiry card.

ACCURATE FREQUENCIES

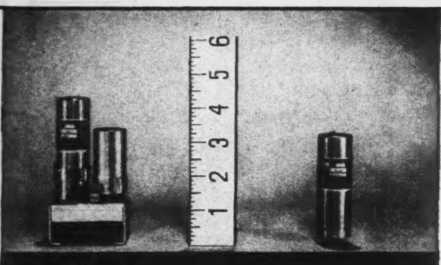
HIGH RELIABILITY
HIGH PRECISION
HIGH QUALITY

LOW WEIGHT
SMALL SIZE
ECONOMICAL

FREQUENCY STANDARD
240 to 800 Cycles

Type 50 C
± .02% at — 65° to 85°C

Type R 50 C
± .002% at 15° to 35°C


8 oz. 4 oz.

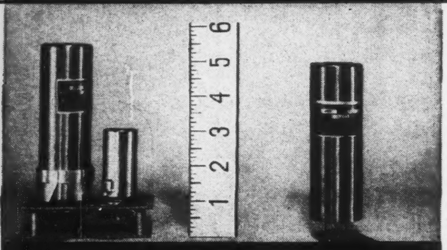
PRECISION FORK UNIT
240 to 800 Cycles

Type 50
± .02% at — 65° to 85°C

Type R 50
± .002% at 15° to 35°C

FREQUENCY STANDARD
200 to 4000 Cycles

Type 2003 C
± .02% at — 65° to 85°C
Type R 2003 C
± .002% at 15° to 35°C
Type W 2003 C
± .005% at — 65° to 85°C

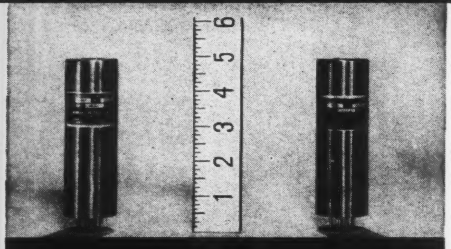

10 oz. 6 oz.

PRECISION FORK UNIT
200 to 4000 Cycles

Type 2003
± .02% at — 65° to 85°C
Type R 2003
± .002% at 15° to 35°C
Type W 2003
± .005% at — 65° to 85°C

FREQUENCY STANDARD
200 to 2000 Cycles
Sub-miniature Tube

Type 2007
± .02% at — 65° to 85°C
Type R 2007
± .002% at 15° to 35°C
Type W 2007
± .005% at — 65° to 85°C


6 oz. 8 oz.

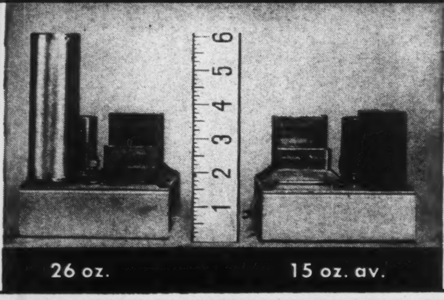
FREQUENCY STANDARD
240 to 1000 Cycles
Transistorized

Type 2007 T
± .02% at — 65° to 85°C
Type R 2007 T
± .002% at 15° to 35°C
Type W 2007 T
± .005% at — 65° to 85°C

FREQUENCY STANDARD
200 to 3000 Cycles

Type 2001-2
± .001% at 20° to 30°C

[WHEN REQUESTING
INFORMATION
PLEASE SPECIFY
TYPE NUMBER]


26 oz. 15 oz. av.

ACCESSORY UNITS
for Type 2001-2

L—for low frequencies, multi-vibrator type, 40-200 cy.
D—for low frequencies, counter type, 40-200 cy.
H—for high freqs., up to 20 KC
M—Power Amplifier, 2W output
P—Power Supply.

American Time Products, Inc.

580 Fifth Avenue *New York 36, N. Y.*

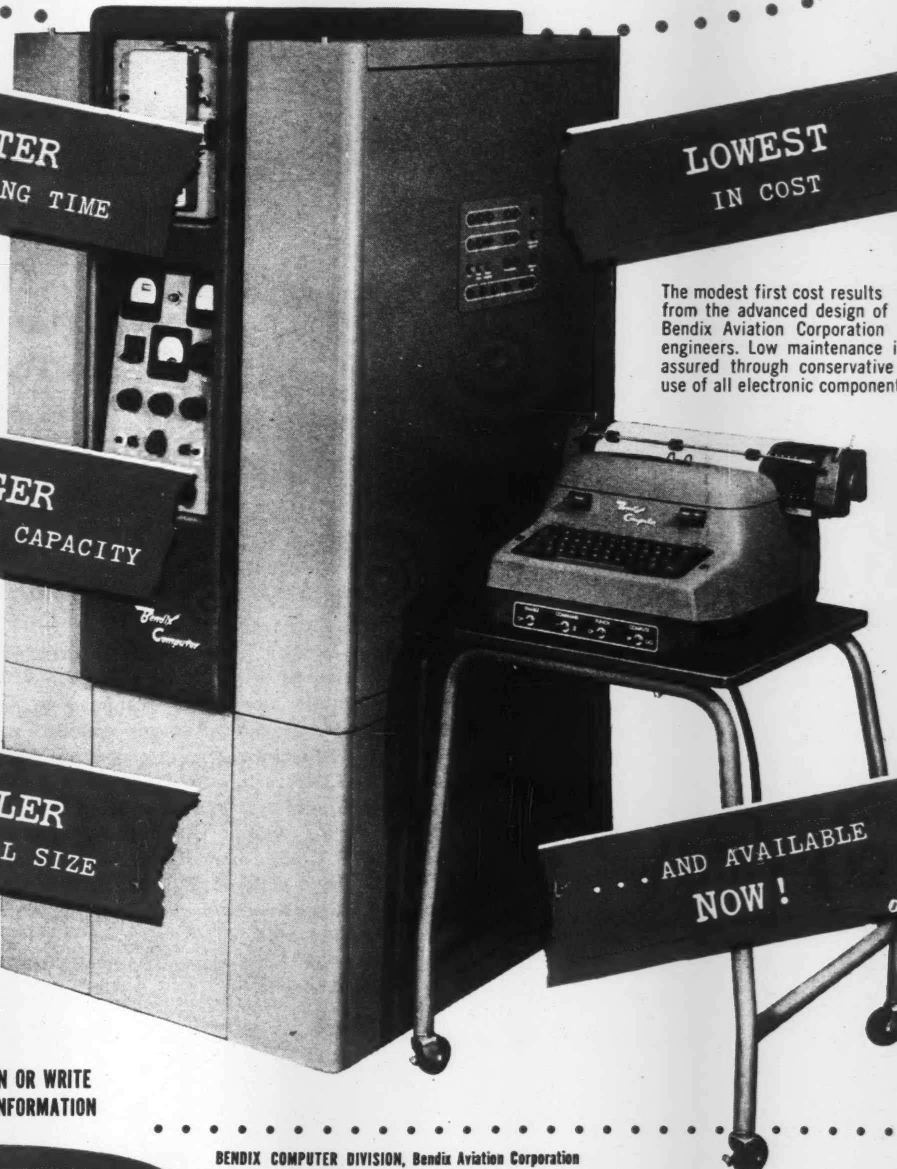
OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY

For more information circle **53** on inquiry card.

Bendix

GENERAL PURPOSE DIGITAL COMPUTER

FOR ENGINEERING AND SCIENTIFIC COMPUTATION



FASTER
IN COMPUTING TIME

Multiplies in 16.7 milliseconds
Divides in 16.7 milliseconds
Adds in 0.54 millisecond
—including reading of command.

LARGER
IN COMPUTING CAPACITY

2176 word memory. As many as 1,200,000 additional words can be stored in auxiliary magnetic tape units.

SMALLER
IN PHYSICAL SIZE

Approximately equivalent in size to 2 standard 4-drawer filing cabinets. Standard 115V 60 cycle current is used.

LOWEST
IN COST

The modest first cost results from the advanced design of Bendix Aviation Corporation engineers. Low maintenance is assured through conservative use of all electronic components.

. . . AND AVAILABLE
NOW!

MAIL THE COUPON OR WRITE FOR COMPLETE INFORMATION

Bendix Computer

BENDIX COMPUTER DIVISION, Bendix Aviation Corporation
5630 ARBOR VITAE STREET, LOS ANGELES 45, CALIF.

Please send information and prices on your G-15A Computers.

NAME__________ TITLE__________

COMPANY__________ ADDRESS__________

T BENDIX G-15A WILL BE EXHIBITED IN TULSA AND HOUSTON DURING FEBRUARY. FOR AN INVITATION PLEASE WRITE THE SALES DEPARTMENT.

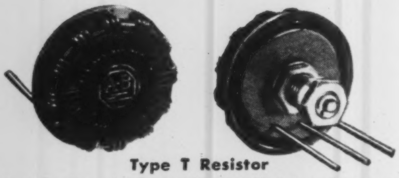
For more information circle **54** on inquiry card.

ACTUAL SIZE
Type G Variable Resistor
ENLARGED VIEW
Type G Variable Resistor
Contact Brush
Molded Resistor Ring

HIGH QUALITY

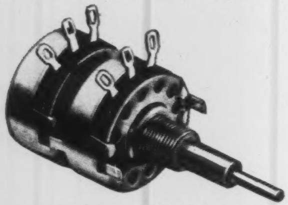
TYPE G

Continuously Variable 1/2 Watt Resistors



Type T Resistor
A ½ watt variable resistor has 2 styles of operating covers—for hand or screwdriver adjustment.

Type J Resistor
A 2 watt solid molded variable resistor available with various types of adjusting shafts.



Dual Type J Resistor with Concentric Shafts
Two units with separate, concentric adjusting shafts for individual circuit control.

Solid Molded Resistor Assures Long Life, Low Noise, and Permanent Characteristics

The tiny Allen-Bradley Type G, ½ watt variable resistor is a miniature version of the well-known Type J 2 watt variable resistor. It has a solid-molded resistor element progressively tapered in resistance to produce any resistance-rotation curve.

The graduated resistor element is NOT a painted or sprayed unit. The Type G element—being solid molded—does not deteriorate with age or use. It is not affected by heat or moisture. It is conservatively rated at ½ watt at 70 C ambient . . . not at the usual 40 C. The carbon contact brush improves with use. The Type G unit is a QUALITY product, through and through . . . made for electronic applications where performance is the dominant requirement.

Let us send you full technical data on Allen-Bradley variable resistors. Write today.

Allen-Bradley Co.
140 W. Greenfield Ave.
Milwaukee 4, Wis.

A-B
Quality

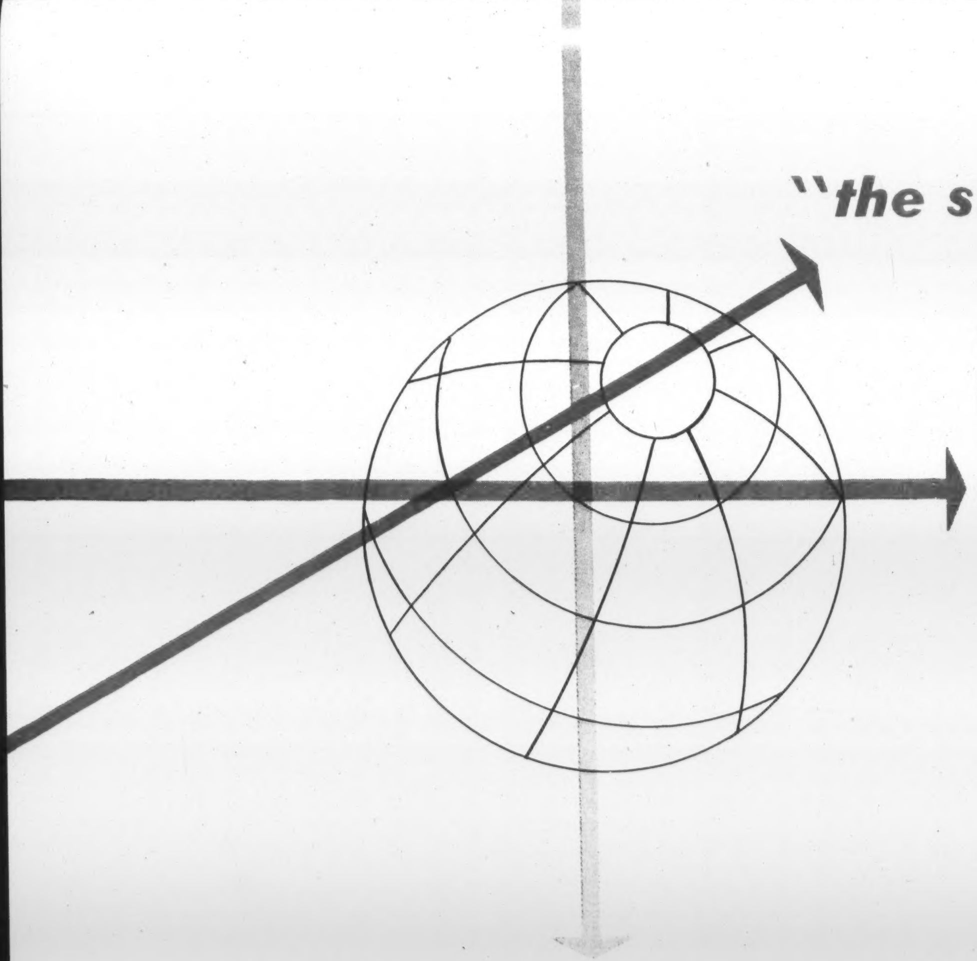
In Canada—
Allen-Bradley Canada Ltd.
Galt, Ont.

ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

For more information circle **55** on inquiry card.

"the show of the future"



THIRD
INTERNATIONAL
automation
EXPOSITION

'56
NEW YORK

NOVEMBER 26-30
New York Trade Show Building

If you have a stake in Automation you'll want to be represented at the most dramatic industrial event of 1956.

Attendance records of the past two shows confirm that this is the one exposition that attracts top-level personnel—those who purchase the systems, controls, instruments, machines and devices of automation. Advance inquiries indicate New York will attract the largest attendance yet.

Also: the Third Show will present a new concept of exhibiting—an all-inclusive price for exhibiting . . . eliminating "nuisance" charges for furniture, lighting, storing, and other services.

For brôchure contact:

RICHARD RIMBACH ASSOCIATES, MANAGEMENT
845 Ridge Ave., Pittsburgh 12, Pa., FAirfax 1-9831

For more information circle **135** on inquiry card.

CONTROL VALVES

The valve is to the field of process control what the motor is to the field of machine tool control. Every phase of production of flowing fluids is under the direct control of valves. This begins a series on control valves—including bodies, actuators, regulators, positioners and control valves of all types.

C. S. BEARD

Foster Engineering Company

THE DISCOVERY of the uses of fire and the invention of the wheel are commonly acclaimed as the most important contributions to our present civilization. Although much more recent in history, the valve should take its place among the devices which are responsible for the greatest impact on our daily life.

You may ask, "What is so interesting about valves?"

Valves are of basic importance to an industrial civilization. They make possible the production, storage, and distribution of gases and liquids—including water, gas, chemicals, petroleum products, steam, foods, and all flowing matter. Valves are used at every stage of the production, distribution, storage, and pressure control of the water you drink, the chemicals used in industry, the gasoline in your car, the steam in your boiler house or generating station, the gas in your kitchen stove, etc., etc. Try to conceive of the number of valves through which the gas you use in your kitchen flows before it reaches your burners. More than 60 valves are used in the average medium-sized house, many of which are regulators or control valves. Valves are indeed an essential, basic, and indispensible control component.

Definition

As to the definition of valves, the Webster's New Collegiate Dictionary says: Mech. Any device by which the flow of liquid, air, or other gas, loose material in bulk etc. may be started, stopped or regulated, by a movable part which opens or obstructs passage.

An oft-quoted definition is "an engineered obstruction in a pipe." Although proposed in humor, this definition is technically correct.

Crude stop-cocks and plugs were used by early civilizations, such as the Babylonians and Greeks. The earliest "engineered obstruction" is accredited to Leonardo da Vinci in the sixteenth century.

Our modern descendants of early stop-cocks bear a close resemblance to the original. Understandable changes have occurred so that the present day cock is made of various metals, is lubricated or designed to make it turn easily, and is equipped with various types of devices for rotating the core in the body. All of the so-called basic designs have long histories. Surprisingly, few truly unique approaches to valve body design have appeared within the last one hundred years. We find that in the eighteen nineties the pressure control valve was an engineered product not much different from those we see today. The valve in Fig. 1-1 appeared in a catalog printed in 1893.

Although many valves of today look like their predecessors, and although there has been little change in the basic design (excluding the few products brought forward by hardy pioneers), refinements are such that almost any degree of control now may be obtained by modern systems in which the valve is an important factor. A primary purpose of this series is to outline and picture the numerous styles of automatic valves, and the variations in the mechanical features that are available today.

Valve specialists and engineers do have one ear cocked and one part of their minds open in search for any method of control which might eliminate the valve. The future may bring wider use of the variable-speed pump or the application of electrical fields or sound wave with which to impede flow, but at the present time the valve remains the basic flow-control tool.

Type of Control

The first consideration in the application of a valve is the determination of the degree of control. There are three choices: the manual operator, the regulator, or the controller.

Manual Operation

Manual operation consists in making it possible for the operator to open or close the valve either at the location of the valve or at a remote board or control center (by use of a servo which may be either mechanical, electrical, pneumatic, or hydraulic). Local hand operation is used generally where the opening and closing is infrequent and does not interfere with the economic use of the operator's time. However, it becomes uneconomical to use an employee's time for this operation if the time involved is great enough to take him away from other duties. The accessibility of the hand valve is related to the time involved for manual control, as is the degree and frequency of opening and closing.

The hand valve is first in our minds for use in on-off operation, usually in one of the following classifications:

a) Isolating a lateral of secondary system from the source or header.

b) Isolating a piece of equipment, either as a block valve or in multiple as with a by-pass. (It is presumed that some other control equipment is being used following this valving.)

c) Allowing flow to a batch system such as filling a tank to a given level or bringing a body of liquid up to a given temperature by applying steam.

d) Quick removal or injection either as in an emergency or an operational procedure. Examples of this use are the quick-opening blow-down valve on a boiler or the valve which is opened to flood an exothermic chemical reaction if it becomes dangerously active.

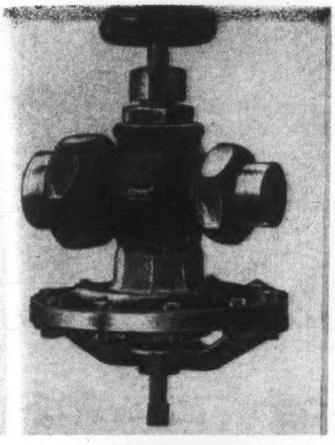


Fig. 1-1. 19th-Century regulator resembles its successors.

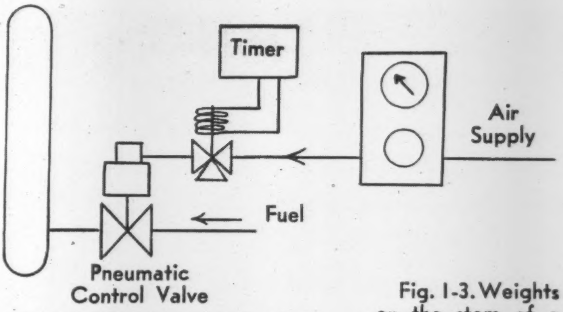


Fig. 1-2. Predetermined valve opening can be duplicated during each cycle by timer and 3-way valve controlling the pneumatic loading of valve.

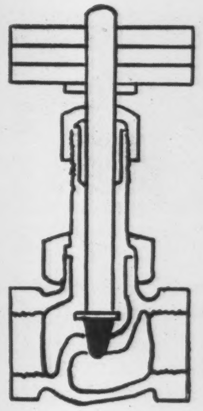


Fig. 1-3. Weights on the stem of a valve make a crude regulator.

These classifications do not intend to disregard the use of a manual valve for throttling action. Any of these general functions may be carried on by opening the valve partially. Close control of a fluid stream could be obtained by an attentive and conscientious individual at the wheel of a manual valve; but he would have difficulty without the use of instruments to indicate the result of valve manipulation. He would need some indication of the degree to which the valve was open, as well as a valve with a reproducible throttling characteristic. (This last requirement is the one responsible for the design of many of the valves used for automatic operation.)

Manual Remote Operation

Use of remote manually operated valves has been the answer to economical operation in many applications which do not justify automatic control. Operators include the extended hand wheel or chain operator, but the more advantageous operators are the pneumatic, electric, or hydraulic actuators which may be operated from much greater distances.

Many plant operations require periodic changes in flow rate or a reproduction of a flow rate at some point in a cycle. Reproduceability of the valve movement may be obtained either pneumatically, electrically or hydraulically by some type of position transmitter which stops the actuator when the valve has opened to the desired point. Pneumatic loading of a diaphragm actuator may be performed by using a three-way valve which is triggered by the cycle control, as in Fig. 1-2. However, positioning the valve stem correctly does not guarantee a correct reproduction of the flow rate. A style of valve with the necessary reproduceability must be used. External conditions of pressure and temperature may vary so that the flow rate may be different even though the valve opening has been duplicated.

The degree of accuracy required will dictate whether a periodic check of flow rate by reference to a flowmeter is adequate, or whether the requirements indicate the use of a flow controller.

This space is devoted to discussion of the hand valve and the remote manual valve because good instrumentation includes the use of the simplest equipment obtainable to get the greatest quantity and the highest quality of product under the safest and best conditions. With this in mind, the next development in the valve is considered.

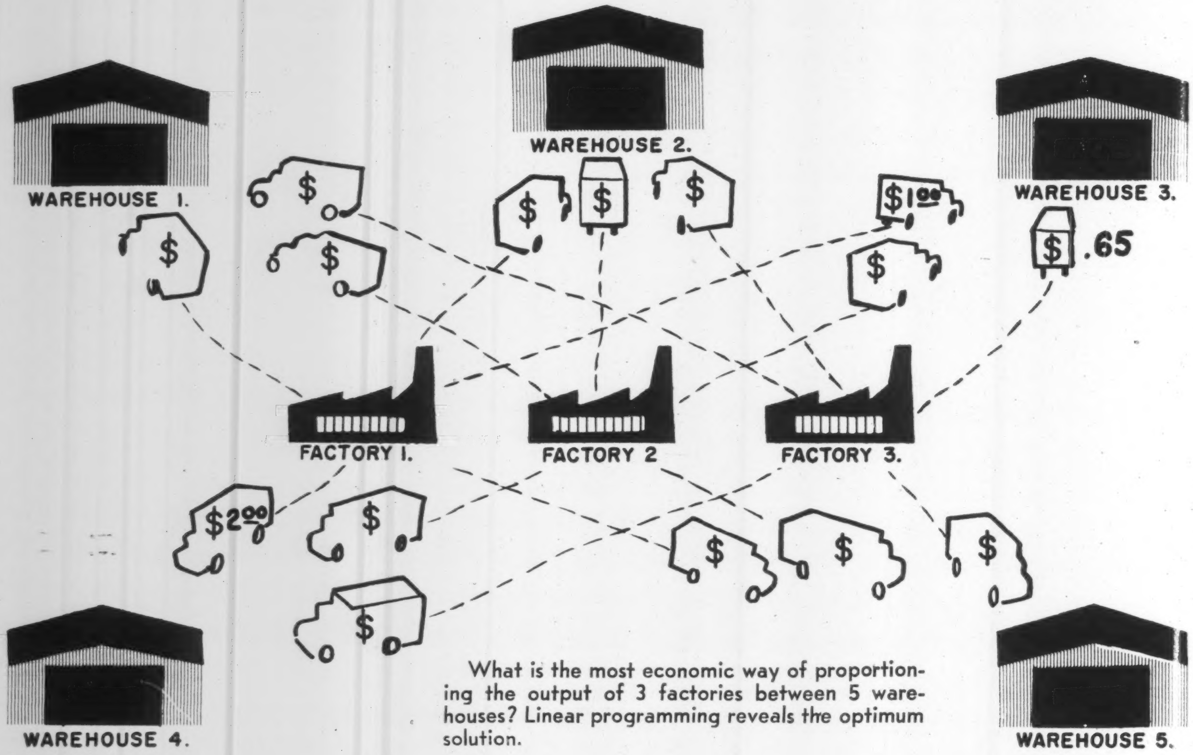
The Regulator

The term "regulator" has come to mean a valve which will, within its own structure, sense a change in pressure, temperature or level, and will open or close in an effort to hold a constant condition. The simplest (although not the most accurate) way to make a pressure regulator would be to place a weight on the stem of the valve (Fig. 1-3) of sufficient weight so that the difference in the pressure that tends to open the valve would hold the valve open just enough to create the desired back pressure ahead of the valve. In a level regulator, a float may operate the valve so as to control level; in a temperature regulator the thermal element may move the main valve as dictated by the temperature effect upon the thermal system. Regulators have been designed and constructed to give acceptable control within the limits of use recommended for the specific regulator. (Later chapters will include discussions on how to decide upon use of regulators or instrument controllers.)

Instrument Control

Instrument control is considered when the condition of operation cannot be met by a regulator. This condition may be the need for close control over wider ranges of flow rate than is possible with the regulator. The condition may require the measurement of a variable (such as pH or flow) which does not adapt itself to direct-operating valves. Nor are regulators used when the measurement is at a point far from the location of the control board.

The manner in which the valve is used for instrument control is completely different from the manner of its use as a regulator. The valve is the slave of the pneumatic or electric output of the instrument, which measures the variable and then tells the valve what to do. As a slave of the controller, the valve can be made to turn handsprings; it can move any desired distance from open to closed; it can move rapidly with a small change in measured variable, or require a large change to move it at all; the inner valve of this automatic valve, which is called a control valve, may be shaped to cause various flow-rate characteristics through the entire travel of the main valve. This series on control valves will include the considerations necessary to select a valve for a service. As a wide variety of designs and methods of use are available, the equipment available on the market will be considered before the technical approach to valve use.


WAREHOUSE 1.
WAREHOUSE 2.
WAREHOUSE 3.
$1.00
$.65
FACTORY 1.
FACTORY 2
FACTORY 3.
$2.00
WAREHOUSE 4.
WAREHOUSE 5.

What is the most economic way of proportioning the output of 3 factories between 5 warehouses? Linear programming reveals the optimum solution.

DIGITAL AUTOMATION

MARTIN L. KLEIN
FRANK K. WILLIAMS
HARRY C. MORGAN

Here it is—a simple, clear and thorough introduction to the new and basic technique of Linear Programming. This is the fourth in this series, and an important contribution to the literature of the field.

LINEAR PROGRAMMING

LINEAR PROGRAMMING is a new subject. It is a technique for finding an optimum solution to problems with many interrelated factors. Mathematically, it can be stated as the problem of minimizing a given linear performance equation subject to given linear restrictions among the variables. (Don't let this frighten you—this means simply the finding of the best solution when all the variables are nicely linear, or nonerratic.)

Logistics Problems

One type of problem which is of great interest has to do with various logistical problems normally considered insoluble, or at best solved by arbitrary judgement. A simple application comes up in conjunction with the output of, say, three factories and the five warehouses which the three factories supply. The factories are located at different geographic locations, as are the warehouses. Accordingly, there is a distribution of shipping costs: it costs, say, $1.00 per unit to ship from Factory 1 to Warehouse 3; $2.00 to ship to Warehouse 5; $0.65 to ship from Factory 3 to Warehouse 3, and so on. The factories manufacture 2000 units apiece, and the warehouses consume the entire output. The question here is what is the optimal arrangement (the cheapest way) for shipping from the various factories to the various warehouses? Shall we ship all of the output of Factory 1 to Warehouse 1, then if we still require units in Warehouse

1, ship the balance from Factory 3 or 2? Shall we distribute the shipments from each factory evenly among all five warehouses? Will this give the smallest shipping cost?

By linear programming, this problem can be analyzed and we find the lowest cost method for distributing the shipments. Suffice it to say that the method of distribution of shipments from factories to warehouses often is proved least expensive under a set of shipping plans which could not be deduced without *programming technique.*

More important, this linear programming yields a positive quantitative measure of the optimal use of all equipment in order to meet any criteria desired—and actual performance can be compared with the best that can be obtained.

Data Recording

In recording large quantities of data we can be confronted with a logistics problem. Suppose that several tests are to be carried on simultaneously with, say, the possible use of three recording centers. Each recording center has a different recording capability because of an unequal number of available recording units. Also, because of various factors (such as experience, instrument uses, connections required) it takes different times at each facility to perform the same test.

Suppose we wish to make a pressure recording and that a nearby recording facility requires 5 hours per instrument per test; a second recording facility might be capable of the same test in 3 hours per instrument per test; a third recording facility might require additional time for changing hookups so that 14 hours are required per instrument per test. How can we use the facilities within their capabilities and the number of tests required to perform the program in the least instrument time? As an alternate possibility, the costs per test might vary from recording facility to recording facility. How can we arrange the program to perform the tests at least cost?

Programming the Instruments of Three Recording Facilities to Perform Five Tests

To make matters somewhat more specific, let us investigate the technique for linear programming of a recording problem. Suppose we have three recording facilities with the same recording instrumentation, but different numbers of instruments. Suppose in the unit of time we are considering (a day or week) we are to conduct five separate test programs simultaneously, in any convenient order, provided all of the tests are completed within the allotted itme. Let the capabilities be as follows:

Facility 1: 100 instruments
Facility 2: 100 instruments
Facility 3: 120 instruments

Total available: 320 instruments.

Let the tests to be conducted be substantially as follows:

Test 1—Requires 40 recording instruments.
Test 2—Requires 40 recording instruments.
Test 3—Requires 80 recording instruments.
Test 4—Requires 80 recording instruments.
Test 5—Requires 80 recording instruments.

Total required: 320 instruments.

This is a complete utilization program. During the unit of time considered, every instrument available is required.

For the first step, we can arbitrarily assign the various facilities among the various tests as shown in Table 4-1.

Table 4-1.—Simple Utilization Program for Allotting Instruments of Three Recording Facilities to Five Tests.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*	*Total*
Facility 1	40	40	20	0	0	100
Facility 2	0	0	60	40	0	100
Facility 3	0	0	0	40	80	120
Total	40	40	80	80	80	320

This has been done by the simplest and most obvious program—that is, we assigned the instruments in each facility until exhausted, and then filled in the remainder. We first assigned facility 1 to test 1; this took 40 instruments. We had 60 left. We then assigned another 40 to test 2. There were now 20 instruments left in facility 1. This we gave to test 3. However, test 3 still required 60 instruments, so we pulled these from facility 2, and so on.

Now let us take cognizance of the *performance capabilities* of each of the facilities. That is, let it take 2 hours per instrument to conduct test 1 in facility 1. Let it take 1 hour per test to conduct test 2 in facility 1; 2 hours per test to conduct test 3 in facility 1, and so on as shown in table 4-2. We revise the diagram and supply these test times per instrument and show them in the upper righthand corner of each box:

Table 4-2.—Utilization Program With Test Times Per Instrument (in Superscript).

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*	*Total*
Facility 1	40^2	40^1	20^2	0^3	0^3	100
Facility 2	0^2	0^2	60^2	40^1	0^1	100
Facility 3	0^3	0^3	0^2	40^1	80^2	120
Total	40	40	80	80	80	320

Now let us investigate the total number of instrument hours we will consume to conduct the tests according to this program. If we multiply the number of instruments in each box by the number of hours required per instrument, we obtain a total number of 520 *instrument-hours* consumed for the entire program. (This is one of the least efficient possible distributions of facilities.) The problem is now to find the optimal arrangement to minimize the instrument time within our time budget and the capabilities of the facilities.

The Mathematical Model

In addition to a diagrammatic presentation (Tables 4-1 and 4-2) the problem could be stated equally well by a few simple linear formulas using a notation in which y_{mn} signifies the instrumentation of facility m needed to conduct test n. Using this notation, we can

The Mathematical Model

In addition to a diagrammatic presentation (Tables 4-1 and 4-2) the problem could be stated equally well by a few simple linear formulas using a notation in which y_{mn} signifies the instrumentation of facility m needed to conduct test n. Using this notation, we can state that the instruments of facility 1 are to be used in all five tests by the following:

$$y_{11} + y_{12} + y_{13} + y_{14} + y_{15}$$

As there are 100 instruments in facility 1:

$$y_{11} + y_{12} + y_{13} + y_{14} + y_{15} = 100 \qquad (1)$$

Similarly for facilities 2 and 3:

$$y_{21} + y_{22} + y_{23} + y_{24} + y_{25} = 100 \qquad (2)$$
$$y_{31} + y_{32} + y_{33} + y_{34} + y_{35} = 120 \qquad (3)$$

These 3 equations merely state that the total number of instruments of the three facilities are being applied to tests 1, 2, 3, 4 and 5.

Test 1 requires 40 recording instruments. We can say that some given number of instruments from all 3 facilities are allotted to this task as follows:

$$y_{11} + y_{21} + y_{31} = 40 \qquad (4)$$

Similarly for the other four tests:

$$y_{12} + y_{22} + y_{32} = 40 \qquad (5)$$
$$y_{13} + y_{23} + y_{33} = 80 \qquad (6)$$
$$y_{14} + y_{24} + y_{34} = 80 \qquad (7)$$
$$y_{15} + y_{25} + y_{35} = 80 \qquad (8)$$

Equations 1 to 3 show that the total number of instruments in all 3 facilities can be applied to the five tests. Equations 4 to 8 show the total number of instruments from the 3 facilities that can be allotted to each of the 5 tests. The equation to be minimized is the sum of equations (9), (10) and (11):

$$\text{Time of Fac. } 1 = 2y_{11} + y_{12} + 2y_{13} + 3y_{14} + 3y_{15} \qquad (9)$$
$$\text{Time of Fac. } 2 = 2y_{21} + 2y_{22} + 2y_{23} + y_{24} + y_{25} \qquad (10)$$
$$\text{Time of Fac. } 3 = 3y_{31} + 3y_{32} + 2y_{33} + y_{34} + 2y_{35} \qquad (11)$$

where the coefficients are the constants representing, in this problem, the number of hours per instrument per test. In the procedure to be described, we are essentially minimizing equations 4-8 subject to the conditions of equations 1-3.

Numerical Technique for Optimalization

We are now confronted with the actual problem of minimizing the number of instrument hours required. Saying this another way, we are to find how to distribute the three facilities among the five tests so that the least number of instrument hours are consumed for the program.

The technique is essentially a *variational method*—we investigate the effect of a unit change. The unit-change effect is tested by changing only a single 0 at a time.

Specifically, we first locate a zero arbitrarily. Looking along the first row of Table 4-2, we find one in the 4th column (y_{14}), the instruments of facility 1 assigned to test 4. There are none, thus a zero. We increase this by a factor of 1. To preserve the total facilities of facilities 1 at 100, we reduce the adjacent 20 by 1.

We must preserve the column total as stated. So in the fourth column we take away a 1 from the 40 below y_{14} and to the third column we add a 1 beneath y_{13}. The new program will thus be as in Table 4-3.

Table 4-3.—First Step in Variational Method is to Increase the First 0 in the Table by 1. This Necessitates All Changes Shown.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*
Facility 1	40	40	$20-1^2$	$0+1^3$	0
Facility 2	0	0	$60+1^2$	$40-1^1$	0
Facility 3	0	0	0	40	80
Total	40	40	80	80	80

Have we increased or decreased the instrument hours required by this program change? We can determine this simply by multiplying the unitary changes by the hours per instrument and find that the total net *change* in hours is:

$$2(-1) + 3(1) + 2(1) + 1(-1) = 2$$

This has not helped us: it will take 2 more hours to operate in this manner. So in the lower righthand corner of y_{14} we put a plus 2 to show we have investigated the effect of a unitary change here and, as it will cost more time, we do not alter the program.

Let us now investigate a unitary change on y_{15}, the fifth column of the first row. We must remember that only one zero at a time can be changed to test each unitary change. However, changing this zero to +1 in y_{15} requires that we make other changes (shown in Table 4-4) in order to conform to the total requirements and facility capabilities. Note that the rows and columns always add a net change of zero. Applying this pattern to Table 4-2 we obtain Table 4-4:

Table 4-4.—Second Unit Change Investigated is Change of +1 in Fifth Column of First Row (y_{15}). This Requires the Five Changes Shown.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*
Facility 1	40	40	$20-1^2$	0	$0+1^3$
Facility 2	0	0	$60+1^2$	$40-1^1$	0
Facility 3	0	0	0	$40+1^1$	$80-1^2$

Multiplying the unitary changes by the appropriate time per instrument test we obtain:

$$2(-1) + 3(1) + 2(1) + 1(-1) + 1(1) + 2(-1) = +1$$

Again we have accomplished nothing. We can do this for each and every zero and mark the unitary change effect in the lower righthand corner:

Table 4-5.—Subscripts Show Time Change Made by Changing Each Zero into Plus One; Only Place Where Improvement Results is in y_{25}—by Increasing Number of Tests at Facility 2 Applied to Test 5.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*	*Total*
Facility 1	40^2	40^1	20^2	0^3	0^3	100
Facility 2	$0_0{}^2$	$0_1{}^2$	60^2	$40_1{}^2$	$0_{-1}{}^1$	100
Facility 3	$0_1{}^3$	$0_2{}^3$	$0_0{}^2$	40^1	80^2	120
Total	40	40	80	80	80	320

Note that the only favorable change that can be effected is by somehow altering y_{25}; we can save time by increasing y_{25}. The most we can do in this direction is to take the 40 instruments assigned in y_{24} and put them in y_{25}, then make y_{24} a zero to keep the row totaling the same. We must also adjust columns 4 and 5 to compensate for the switch so the columns still add up correctly. This results in Table 4-6.

Table 4-6.—Program Diagram Resulting From Shift of 40 Instruments from y_{24} to y_{25}.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*
Facility 1	40^2	40^1	20^2	0^3	0^3
Facility 2	0^2	0^2	60^2	0^1	40^1
Facility 3	0^3	0^3	0^2	80^1	40^2

Let us now find the total hours required for the program. Multiplying the number of instruments used by the time per instrument test, we obtain:

$$40(2) + 40(1) + 20(2) + 60(2) + 40(1) + 80(1) + 40(2) = 480$$

As the original program required 520 hours, this program modification results in a definite savings in time. We now repeat the procedure of making unitary changes, one at a time, on this second solution—and obtain the following diagram which shows the effect of *each* unitary change:

Table 4-7.—Program Showing Effect of Unit Change in Each Zero Column. Improvement can be made by Increasing y_{33}.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*
Facility 1	40^2	40^1	20^2	0_3^3	0_2^3
Facility 2	0_0^2	0_1^2	60^2	0_1^1	40^1
Facility 3	0_0^3	0_1^3	0_{-1}^2	80^1	40^2

Our re-arrangement now hinges about y_{33}. We therefore shift the 40 instruments from y_{35} to y_{33}, making the necessary column adjustments simultaneously. This gives us the program in Table 4-8.

Table 4-8.—Second Modification in Program Involves Shifting the 40 Instrument in Column y_{35} to Column y_{33}.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*
Facility 1	40	40	20	0	0
Facility 2	0	0	20	0	80
Facility 3	0	0	40	80	0

This is our third solution. We now repeat the process of unitary changes once more, and obtain the diagram in Table 4-9.

We see that we can gain nothing more by a re-arrangement of the assignments, so we therefore have an optimal solution for our problem. By calculating the total instrument time with this solution, we find it to be:

Table 4-9.—Effect of Unit Changes in Zero Columns of Program Given in Table 4-8.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*
Facility 1	40^2	40^1	20^2	0_2^3	0_2^3
Facility 2	0_0^2	0_1^2	20^2	0_0^1	80^1
Facility 3	0_1^3	0_2^3	40^2	80^1	0_1^2

$$40(2) + 40(1) + 20(2) + 20(2) + 80(1) + 40(2) + 80(1) = 440 \text{ hours}$$

Thus we have effected a net saving of 80 instrument-hours of instrument time over the original arrangement. Note that the 0's appearing in subscript in Table 4-9 indicate there are other possible arrangements which will give the *same* optimal value, but these will not be considered here. This is a problem known as *degeneracy*.

Other Uses

Many problems can be attacked by the methods described. For example, we could consider a large instrument pool from which instruments for recording are to be drawn for use. These may be of different manufacture and operating cost, but of substantially equal performance. The question might be how to distribute the instruments among many tests to arrive at the least *expensive* way of conducting the tests. Using the same figures above, our diagram for this problem might appear as in Table 4-10.

Table 4-10.—Typical Program for Instrument Distribution Based on Rental Costs of Each Instrument.

	Test 1	*Test 2*	*Test 3*	*Test 4*	*Test 5*	*Total*
Instrument 1	$40^{\$2}$	$40^{\$1}$	$20^{\$2}$	$0^{\$3}$	$0^{\$3}$	100
Instrument 2	$0^{\$2}$	$0^{\$2}$	$60^{\$2}$	$40^{\$1}$	$0^{\$1}$	100
Instrument 3	$0^{\$3}$	$0^{\$3}$	$0^{\$2}$	$40^{\$1}$	$80^{\$2}$	120
Total	40	40	80	80	80	320

Inosfar as a high-speed data-reduction system is concerned, we can also make use of this methodology to determine how best to use this data-reduction system. For example, instrumentation of certain tests is often committed to existing recording units. On attempting installation and conversion to a completely automatic data-reduction system, a progressive switchover would probably be used. It is possible, using the methods above, to determine the least expensive method in time and money or both to make a progressive switchover.

At present, work in linear programming is finding applications in many unrelated fields—from agriculture to inventory control. It can be of great value in any field where complex possibilities in logistics are concerned. Such complex problems can be solved rapidly using digital computers, once the techniques of linear programming are understood.

Acknowledgment

The assistance of Dr. George Danzig, Rand Corporation, Santa Monica, Calif., is acknowledged in the preparation of this material on linear programming.

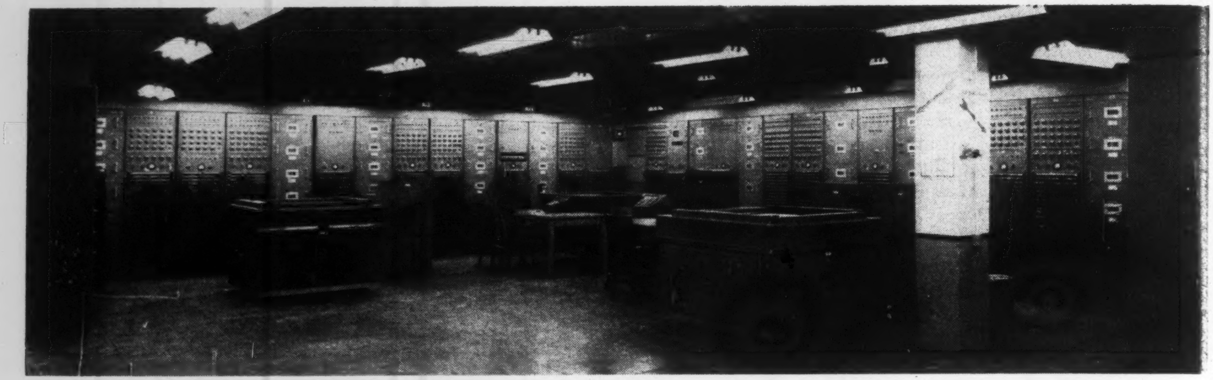


Fig. 1. Project Cyclone Simulation Laboratory No. 1 contains 13 REACs, 14 servo units and 3 auxiliary computing cabinets (with 420 computing amplifiers and 1 limiting amplifiers).

This report on the analog-computer equipments required for solution o problems requiring up to 300 amplifiers gives (1) perspective on problem types and (2) techniques for problem set-up, run, and check. Accurac is shown to be unimpaired by large size of problems. Three-dimensiona simulation and continuous resolution techniques are also discussed

Large-Problem Solutions At

PROJECT CYCLONE at Reeves Instrument Corporation was established under the sponsorship of the U. S. Navy Special Devices Center. Cognizance of the Project was transferred in 1952 to the U. S. Navy Bureau of Aeronautics. During the past nine years, the Project has been engaged in the solution of guided-missile simulation problems and problems in navigation, ballistics, engine control, electrical circuit analysis, etc.

Computing time in the laboratory is assigned by the Bureau of Aeronautics; arrangements should be made with Mr. J. Kanter, Code EL-4251, Bureau of Aeronautics.

Computing Equipment

Laboratory 1 (Fig. 1) contains 13 REACs*, 14 servo units and 3 auxiliary computing cabinets. These house 420 computing amplifiers and 12 limiting amplifiers. The servo units make available 42 shaft rotations with 42 d-c resolvers on 27 of these rotations. Additional equipment consists of diode function generators, REAC recorders, plotting boards, and input-output equipment.

Laboratory 3 contains modified older equipment. There are 5 REACs, 4 servo cabinets, and 2 special cabinets containing 120 amplifiers and 8 limiting amplifiers. The servo units provide a total of 16 shaft rotations. Eight of these shaft rotations are utilized for a-c resolvers. Interlab wiring has been installed so that computing connections can be made between the laboratories.

This article is concerned with three problems, each requiring approximately 200 amplifiers, which have been

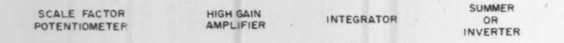

SCALE FACTOR POTENTIOMETER
HIGH GAIN AMPLIFIER
INTEGRATOR
I.C.
SUMMER OR INVERTER
DIODE BRIDGE LIMITER
IN
OUT
+
−
LINEAR POTENTIOMETER
FUNCTIONAL POTENTIOMETER
LIMITING AMPLIFIER
SERVO
FUNCTION GENERATOR
y
F
f(y)
ELECTRONIC MULTIPLIER
u
v
X
−uv/100
ELECTRICAL CONNECTIONS
DIODE
CRYSTAL DIODE
Arrow shows direction of "easy" current flow
RESISTOR
GROUND
CAPACITOR
MECHANICAL CONNECTIONS
DIFFERENTIAL RELAY
RELAY
Excitation Voltage
Normally Closed
Arm
Normally Open
NC
A
NO
L
switch
D. C. RESOLVER
A
B
A cos
B sin
B cos
−A sin

Fig. 3. Symbols for mechanisms used in analog-computer schematics. Note particularly the symbol for "mechanical connection" and "d-c resolver" because the resolver is mechanically coupled to a servo.

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*REAC® is a registered trademark of the Reeves Instrument Corp., 215 E. 91 St., N. Y. 28, N. Y.

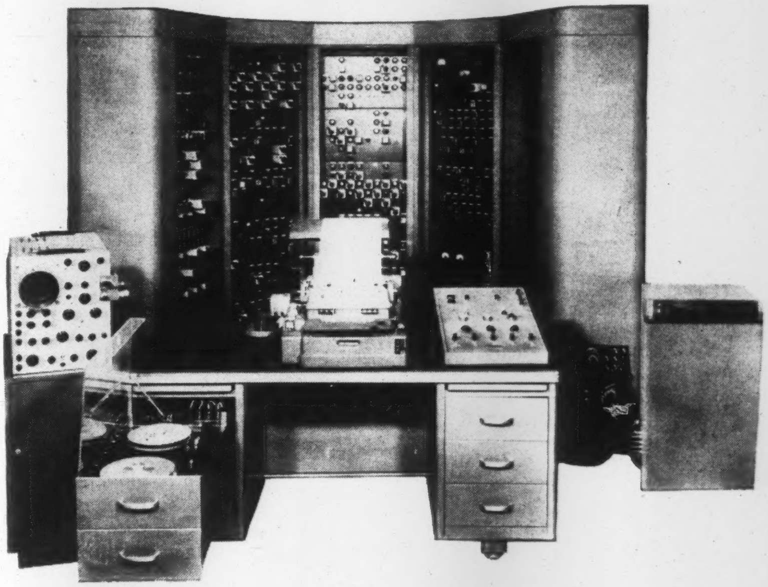

Fig. 2. Elecom 100 digital computer is used to check REAC solutions. (Photo courtesy Underwood Corporation)

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Reeves Instrument Corporation

PROJECT CYCLONE

rogrammed and run successfully at Project Cyclone. A rief description of the problems and their solution is resented. Solutions obtained on the REAC have been ompared with digital solutions obtained in one case on he IBM CPC, and in the other two on the Elecom 100 ocated at Project Cyclone. The analog solutions are in xcellent agreement with digital checks, as will be seen.

Three general questions will be answered in the course f this discussion:

1. Are full, three-dimensional simulations practicable?
2. The related question: are large simulation facilities necessary?
3. Is accuracy sacrificed in the course of providing the complicated circuitry required?

That complete, three-dimensional simulations are desirable cannot be denied. Their practicability, as demontrated by the experience of Project Cyclone, has not een widely publicized.

The problems have included cross-coupling terms which omplicate the motion of an airframe in three dimensions among them: dynamic and kinematic cross-coupling in he force and moment equations, kinematic cross-couling in the equations yielding airframe position and orintation in the fixed coordinate system, cross-coupling rrors originating in sensing equipment affecting the ttitude control system, etc.). Information has been obained which has been used, for example, to determine hich of the exact relations may be approximated by impler expressions, what degree of complexity is reuired of guidance and control systems, etc.

Elaborate computing facilities are required for simuation of the airframe, the aerodynamics, the kinematics, coordinate transformations, guidance and control equipment, etc. Opinions have been expressed regarding desirable upper limits for such facilities, and fears have been expressed as to the increase in machine and operator error, the decrease in accuracy, the disproportionate amount of time spent in trouble shooting, the greater difficulties involved in checking solutions. We shall content ourselves at this point by stating that the successful solution of problems of this magnitude at Project Cyclone in periods of time commensurate with their size and complexity has shown these fears to be unfounded.

A brief discussion of analog techniques for coordinate transformations in three dimensions, and some special circuit problems encountered in programming, also will be presented.

Three-Dimensional Simulation

The design philosophy of Laboratory 1 at Project Cyclone is based on flexible operation and use of d-c computing equipment throughout the laboratory. Flexible operation has two advantages over a prewired setup with predetermined scale factors—(1) the equations of motion can be solved in any coordinate system rather than in certain coordinate systems and (2) only the equipment required for a specific problem is used.

Use of all d-c computing equipment was accomplished by the introduction of precision d-c resolvers in place of the a-c resolvers previously used. This eliminated static and dynamic errors attributable to the modulation and demodulation required with a-c resolvers.

The availability of d-c resolvers (Fig. 3) led naturally

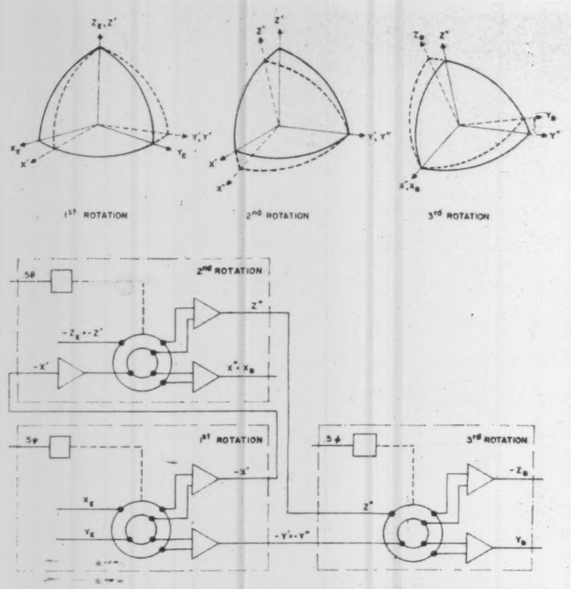

Fig. 4. Geometry for making 3-dimensional coordinate transformation by use of Euler angles (top), and simulator setup for effecting the transformation (bottom). Servos and d-c resolvers are used in the simulation setup.

to the use of *Euler angles* for three-dimensional coordinate transformations. This is easily effected, as shown in Fig. 4. The transformation shown is from a fixed to a rotating coordinate system. The inverse transformation also is implemented readily. Pitch, roll, and yaw angle rates are easily obtained.

This method recommends itself because of its simplicity, and because none of the equipment used need be tied up if not needed in a problem. The accuracy obtained from computing with this method is excellent, as will become apparent from comparisons of analog and digital solutions. An additional advantage lies in the fact that all variables of interest can be obtained easily.

The method is limited by the frequency response of the resolver servos, but the limitation can be circumvented by extending the time scale of the problem. If actual hardware is to be incorporated into the simulation, the time scale cannot be altered. In problems solved at Project Cyclone, both with and without hardware, no difficulty has been experienced because of this limitation. Removal of the limitation depends on the possibility of developing electronic resolvers. This possibility should not be discounted.

Another limitation is gimbal lock. If the Euler angle rotations are considered in order (yaw ψ, pitch θ, roll ϕ) the second of these cannot be permitted to go to 90°. At this value of θ, the Jacobian of the transformation is zero, and the inverse cannot be obtained. This limitation has been no serious drawback. The pitch angle, which is chosen to be the second of the rotations, does not go as high as 90° except for maneuvers rarely encountered in this type of investigation. Should the pitch angle reach 90°, as in a vertical launching study, the yaw angle is chosen to be the second rotation (θ, ψ, ϕ); and gimbal lock is thus avoided.

An alternative method for dealing with coordinate transformations is that of *direction cosines,* which we have had no occasion to use at Project Cyclone. This method is not limited by gimbal lock. Another advantage of this method is the possibility of performing the multiplications electronically, leading to improved frequency response. However, in computing the direction cosines, care must be taken to satisfy the six constraint conditions during the calculation.

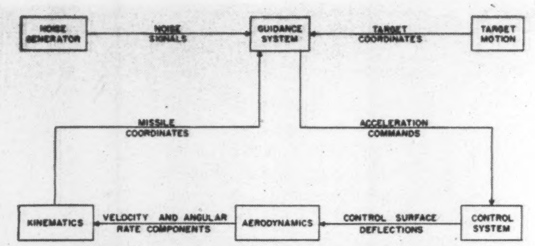

Fig. 5. Block diagram of 3-dimensional guided-missile problem involving guidance by computer circuit. Equipment used to simulate this problem included 304 amplifiers and 369 potentiometers.

Use of the direction-cosine method may not eliminate the need for an Euler-angle calculation. The Euler angles would still be required if, for example, the rates of change of the pitch, roll, and yaw angles are desired.

Preparing the Problem

Problems of the size and complexity of those to be considered are run in accordance with the following procedure. Before patching in a major problem, all electronic and electromechanical equipment is checked by the maintenance staff. Necessary repairs and substitutions are made.

As the problem is patched in, partial checks of the wiring are made by the operators. Upon completion of the patching, a thorough functional check is carried out. Static checking usually results in the elimination of minor malfunctioning and wiring errors.

Runs then are made to detect dynamic errors and drift, followed by checks of transient and steady-state responses (compared with hand-calculated solutions) for a variety of initial conditions. The system is linearized, and necessary simplifications are made for this purpose. When the simulator has passed these tests it is considered ready for three-dimensional solutions which are checked against digital solutions provided by the contractor or prepared on the Elecom 100 at Project Cyclone (Fig. 2).

We wish to repeat and emphasize the fact that the checking procedure demands, in addition to maintenance and functional checks, the agreement of two solutions obtained independently. This requirement may be satisfied by a numerical solution calculated either by hand, by an automatic digital computer, or by a digital differential analyzer. The first of these is generally not feasible because of the time element.

Running the Problem

When the operators are satisfied that the machine is functioning properly, the problem is run. In general, studies are made of the sensitivity of solutions to variations in problem parameters. The problems range in magnitude from a minimum of 1,000 runs to a maximum of 6,650. (A single "run" is a solution to the problem for a prescribed set of conditions.) The average running time for a single solution is approximately one minute.

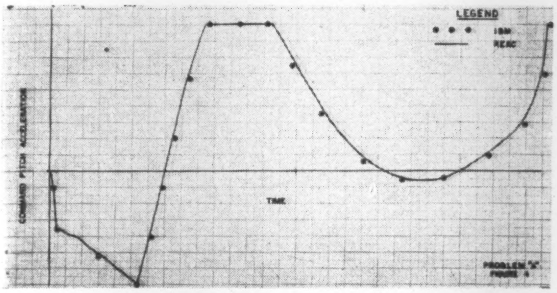

Fig. 6. One variable desired (of the 23 variables involved) in the guided-missile problem was command pitch acceleration. Shown is analog-computer solution and digital (IBM) check.

For purposes of comparison, the IBM CPC check solution required 75 hours, and the Elecom 100 check solutions ran from 60 to 130 hours.

Two criteria are used for checking during the running of the problem. One is the reasonableness of the solution: the other is repeatability of solutions. Not only are check solutions re-run from time to time, but the last previous solution is re-run after any lapse in simulator use.

Three problems will be discussed in the remainder of this article. They will be referred to as Problems A, B, . All were solved in Laboratory 1.

Problem A—Guided-Missile Study

The missile is launched from a fighter. Deviations from an ideal collision course are sensed by its seeker and used by the guidance computer to generate steering signals. The main objectives of this study were to investigate (1) the effectiveness of the configuration with respect to roll control while complex steering maneuvers were executed; (2) the effect of various guidance methods on performance: (3) the error-sensing and resolving characteristics of the seeker.

A block diagram of the simulation setup for Problem A is shown in Fig. 5.

The equipment used consisted of 304 amplifiers, 369 potentiometers, 20 single- and 5 double-tray multiplying servos, 5 single- and 3 double-tray resolvers, 8 diode function-generators, and 2 noise generators. The complexity of this problem can be described also in terms of the mathematical operations performed. These consisted of 24 integrations, 103 products of two variables, 5 divisions, one square root, and the generation of 15 sines, 15 cosines, one tangent, one secant, and 8 arbitrary functions.

Two variables are shown in Figs. 6 and 7. Fig. 8 is a relative trajectory. The digital solutions with which they were compared were provided by the contractor. Unfortunately, values of these variables cannot be shown. The comparisons chosen are representative of the twenty-three variables involved in the study. Agreement between the REAC solution and the IBM CPC solution is excellent.

Problem B—Flight-Trainer Simulation

Problem B is a flight-trainer simulation involving only aerodynamics and kinematics. The study is essentially a simulation of a simulator for a specific aircraft. A block diagram is given in Fig. 9.

Interest was centered on the following aspects:

1. Agreement of solutions obtained at Project Cyclone with those obtained from the flight trainer computer.
2. Agreement of simulation data with flight data.
3. Justification for simplifications and approximations utilized in the flight trainer.

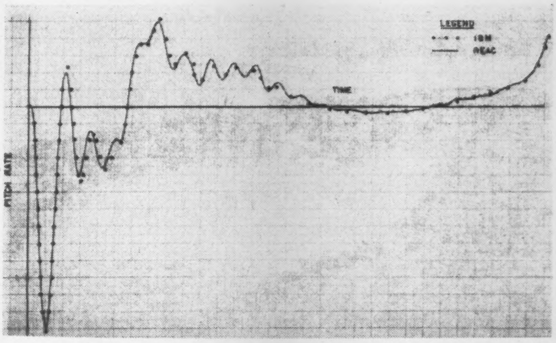

Fig. 7. Another variable desired was pitch rate of guided missile. Shown are analog-computer solution and digital-computer check. Note the close agreements.

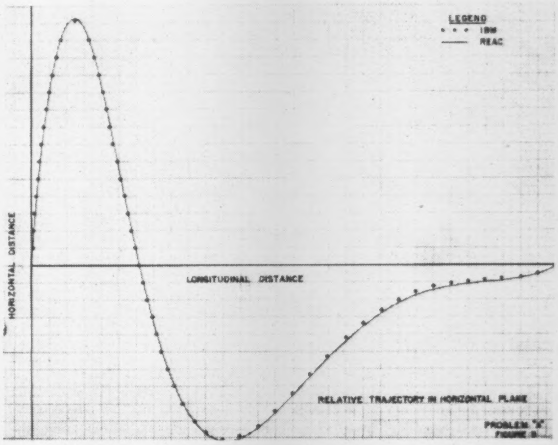

Fig. 8. Relative trajectory (between guided missile and target) in horizontal plane as obtained by analog computer (solid line) and digital-computer check (dots).

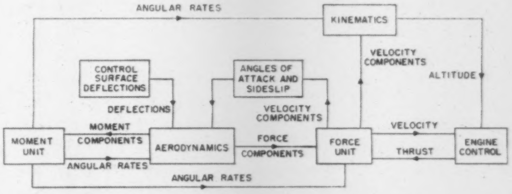

Fig. 9. Another 3-dimensional problem is a flight-trainer simulation problem involving only aerodynamics and kinematics. Analog-computer equipment used in simulating trainer included 167 amplifiers and 201 potentiometers.

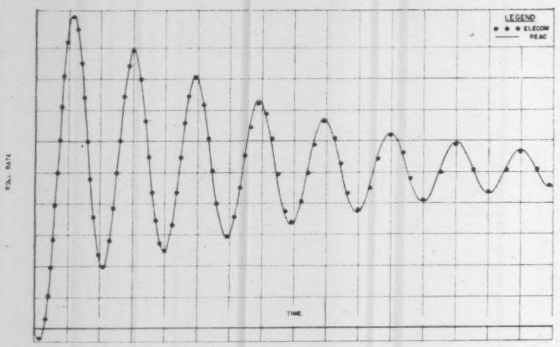

Fig. 10. Roll rate was one of the many variables investigated in the flight-simulator problem. Check solution (dots) was obtained with an Elecom 100 digital computer.

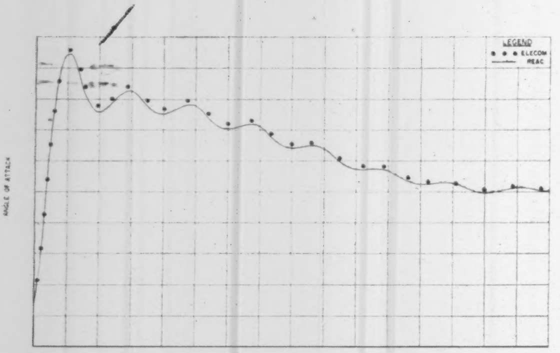

Fig. 11. Angle of attack was another variable investigated in the flight-simulator problem. Check solution was obtained with an Elecom 100 digital computer.

4. Effect of additional approximations in the mathematical formulation.
5. Determination of reasonable bounds for the variables involved.
6. Effect of servo time lags on the simulation.

The equipment used in this investigation consisted of 167 amplifiers, 201 potentiometers, 15 multiplying servos, 5 single resolvers, 2 double resolvers, 7 diode function-generators, and a function generator servo. The mathematical operations consisted of 14 integrations, 54 products of two variables, 2 divisions, and the generation of 6 sines, 6 cosines, one tangent, one secant, 7 arbitrary functions of one variable and 7 of two variables.

Whereas functions of one variable are easily generated (by means of photoformers, tapped potentiometers, diode function-generators, functional potentiometers, or other curve following devices), the situation is altogether different for functions of more than one variable. Several methods for generating functions of two variables may be found in the literature.

Problem B required the generation of 7 functions of two variables which could not be broken down to simpler forms. To meet this need, a function-generator servo was constructed. This consists of a servo driving a followup potentiometer and twelve tapped potentiometers. The tapped potentiometers are single-turn 100,000-ohm potentiometers with nine taps for each (ten sections). These are arranged in three banks of four potentiometers each.

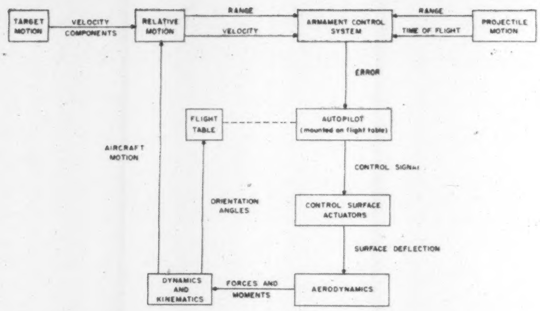

Fig. 12. Flight-table problem involved evaluation of armament control system. Analog-computer equipment included 200 amplifiers and 277 potentiometers.

In order to generate monotonic functions of one variable, padding resistors are added between taps. Nonmonotonic functions of one variable, or functions of two variables, are generated by applying external voltages at some of the taps. In the case of nonmonotonic functions, these voltages are proportional to the voltages applied to the ends of the potentiometer. In the case of functions of two variables, the voltages applied to the taps are functions of one variable, and the servo is driven by the other variable.

Two of the many variables investigated are shown in Figs. 10 and 11. Comparison solutions were prepared on the Elecom 100, as were those for Problem C. As before, the values of the variables are concealed. Agreement is as good as in the previous problem.

Problem C—Flight-Table Simulation*

Problem C is a flight-table simulation, a block diagram of which is shown in Fig. 12. The results of this study are to be used in the design of a simulator and test equipment for the evaluation and improvement of armament control systems. Some aspects of the simulation program were an investigation of test system properties, identification of those components to whose errors the control system evaluation would be most sensitive, a comparison of various methods of interconnecting the test system components, and an investigation of the accuracy obtained with given errors in the components.

The specific objectives of each phase of this investigation were (1) determination of maximum accelerations and velocities during transients; (2) effect of time scale changes on simulation servos; (3) effect of simplifications in the aerodynamics computer; and (4) effect of flight table drive delays.

Equipment used consisted of 200 amplifiers, 277 potentiometers, 8 single- and 5 double-tray multiplying servos, 4 single- and 3 double-tray resolvers, 1 quadruple-tray continuous resolver, 4 diode function-generators, and 10 functional potentiometers. The mathematical operations performed were 25 integrations, 73 prod-

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*A flight table is a surface (or table) which can be rotated to a desired orientation. Depending on the number of degrees of freedom it is referred to as a one-, two- or three-axis flight table. Servo drives are used to provide the rotations commanded for each axis. Hardware such as gyros and accelerometers are usually mounted on the flight table, and signals from these are brought to external control equipment. The entire system (flight table, gyros, accelerometers and control equipment) is used to simulate a flight situation. This technique is sometimes called physical simulation. By comparison, mathematical simulation consists of describing the entire system by a set of equations and then solving them on the computer without any external gear.

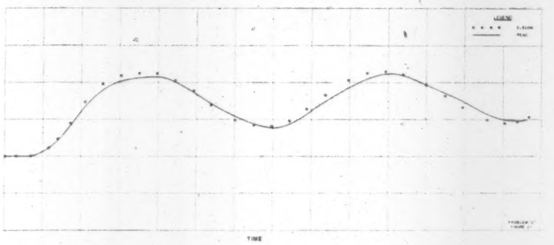


Fig. 13. REAC pitch-rate solution in flight-table problem is checked with Elecom 100.

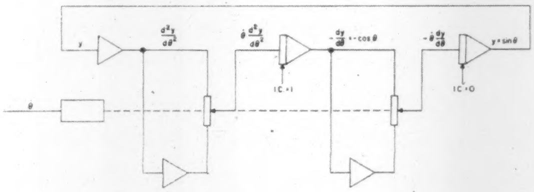

y
$\frac{d^2y}{d\theta^2}$
$\dot{\theta}\frac{d^2y}{d\theta^2}$
$-\frac{dy}{d\theta} = -\cos\theta$
$-\dot{\theta}\frac{dy}{d\theta}$
$y = \sin\theta$
IC = 1
IC = 0
θ

Fig. 14. Technique for continuous resolution of an angle is based on differential equation $d^2y/d\theta^2 = -y$ (which has the solutions $y = \sin\theta$; $dy/d\theta = \cos\theta$).

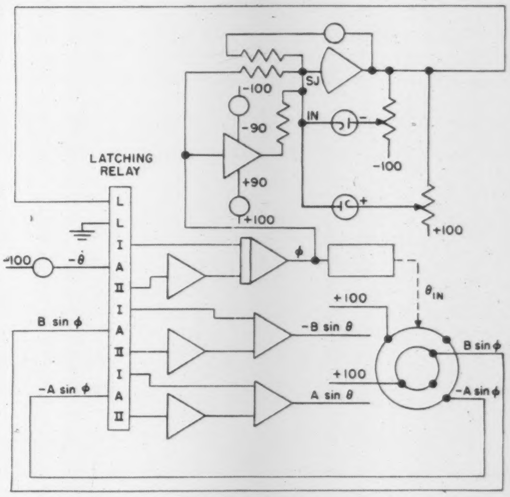


Fig. 15. Another technique for continuous resolution of an angle uses standard resolver with switching circuit and latching relay.

ucts of two variables, 2 divisions, and the generation of 10 sines, 10 cosines, one secant, one tangent, and 14 arbitrary functions.

A typical check solution from this study is shown in Fig. 13. Agreement is again excellent.

Continuous Resolution

A problem which arose in these studies was that of continuous resolution with respect to the roll angle. This need was partially met by construction (by the Reeves Instrument Corporation) of a continuous-resolution servo consisting of a rate servo driving four sine-cosine potentiometers on the same shaft.

Two other techniques for continuous resolution have been used with some success. One is based on the differential equation

$$\frac{d^2y}{d\theta^2} = -y$$

with solution

$$y = \sin\theta; \quad \frac{dy}{d\theta} = \cos\theta$$

The schematic for this is given in Fig. 14.

The other combines a switching circuit using a latching relay with standard resolvers (Fig. 15). The method is described in a technical note[3] issued by Project Cyclone. This circuit has been altered, to obtain improved response, by the substitution of a differential relay coupled to a self-locking circuit for the latching relay.

Conclusions

The solution of three large problems has been reported. It is felt that this is sufficient experience upon which to base the following conclusions:

1. The feasibility of solving full, three-dimensional problems has been established.
2. Accuracy has not been impaired in problems requiring as many as 300 amplifiers.
3. The time spent in maintenance, trouble-shooting and checking is not disproportionate to the size of the problem.
4. No conclusion can be drawn regarding a reasonable upper limit for the amount of equipment that can be employed successfully in a problem, and consequently no estimate can be made regarding maximum size for simulation facilities.

Acknowledgement

The authors wish to express their appreciation for the contributions made to this paper by their colleagues at Project Cyclone. The paper was presented at the ACM Meeting, Philadelphia, Sept. 16, 1955.

References

1. Bauer, L.; *New Laboratory for Three-Dimensional Guided Missile Simulation,* Joint Computer Conference, February, 1953.

2. Project Cyclone Technical Note 2: *Specialized Equipment at Project Cyclone.*

3. Glatt, G. and Wouk, A.; Project Cyclone Technical Note 3: *Continuous Resolver Using Latching Relay.*

4. Meissinger, H. F.; *An Electronic Circuit for the Generation of Functions of Several Variable,* Technical Article Reprint No. 101, Reeves Instrument Corporation, 215 E. 91 St., N. Y. 28, N. Y.

ELECTRONIC

MILTON H. ARONSON

and

CHARLES F. KEZER

REGULATED 1000-V SUPPLY OF ADJUSTABLE VALUE AND POLARITY

Used in a fast-neutron spectrometer, this power supply provides regulation of 80 parts per million per day. Output voltage is adjustable over the range from zero to 1000 volts.

Two strings of gas regulator tubes are used: the first, consisting of types OA2 and OB2 in series, operates at combined anode voltage drop of 1150 volts (anode drop of the OA2 is 150 v dc; OB2 voltage drop is 108 v dc). The second string of regulator tubes consists of 11 type 5651. At 3 to 3.5 ma, these have voltage drops of about 90 volts each, so that the combined drop is nearly 1000 v.

The half-wave rectifier (5R4) operates from a 1200-v-rms secondary of the stepup transformer (UTC S41). Radio-frequency interference which might be fed in via the power line is removed by the filter (10-mh) chokes and small (0.01-uf) capacitors. Ripple is removed in successive stage of L-C and R-C filters. Filter chokes and resistors are connected in both positive and negative lines so that either side of the output may be grounded to obtain output of either polarity.

Resistors R10 and R11 are the series resistors for the second string of regulator tubes. They have nominal values of 24K ohms, but are selected to provide 3 to 3.5 ma current in the 5651 tubes with maximum line voltage and no load. Output voltage is coarsely adjusted by selector switch S2, which picks off as output the step of voltage across any of the 5651's. Fine variation of voltage within a step is by means of 50K potentiometer R13.

Maximum load current is about 1 ma: internal impedance depends on the position of R13, and may reach 12K ohms or more. Switch S3 reverses the output polarity, switching the indicating voltmeter at the same time.

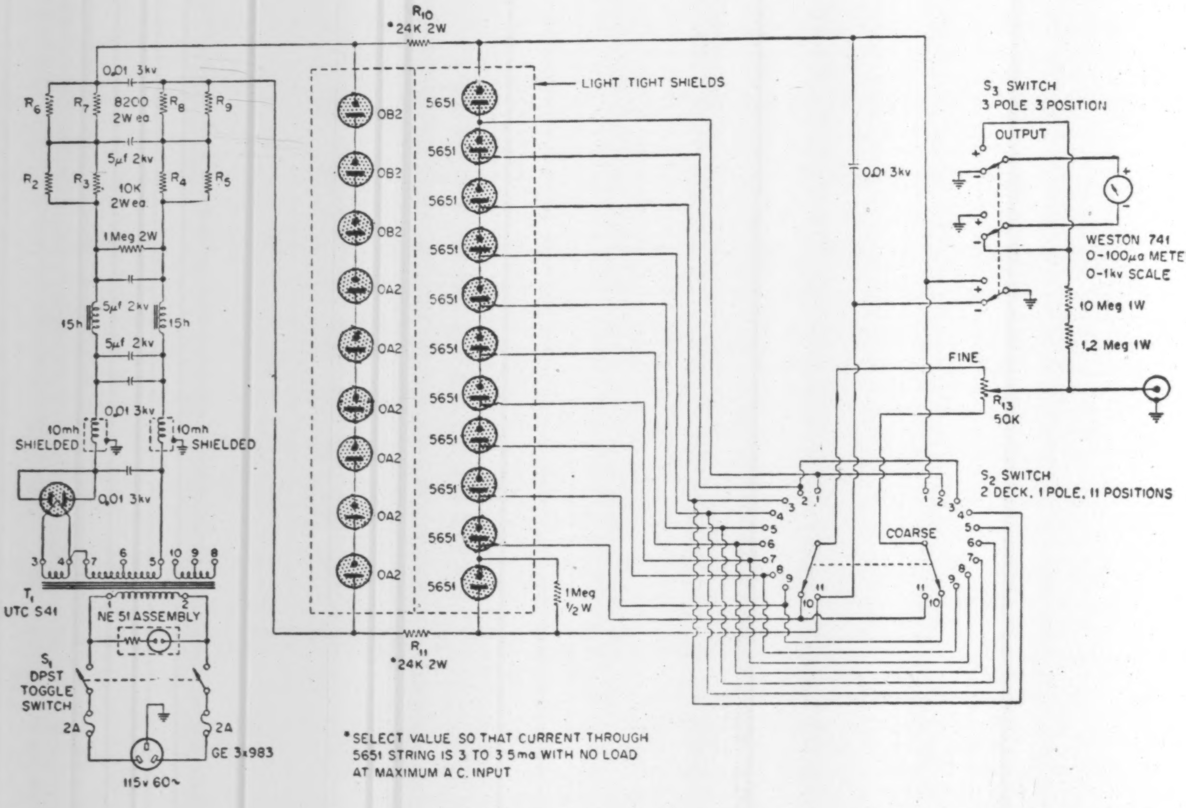
Output voltage: Adjustable, 0-1000 v dc, either + or —.

Load current: 1 ma maximum.

Regulation: For constant load, 80 parts per million per day.

Output impedance: Depends on setting of R13; estimated at 12K ohms maximum.

Source: R. G. Cochran (Penna. State Univ., Univ. Park, Pa.) and K. M. Henry, (Oak Ridge National Laboratory, Oak Ridge, Tennessee); also, *Review of Scientific Instruments*, August, 1955.

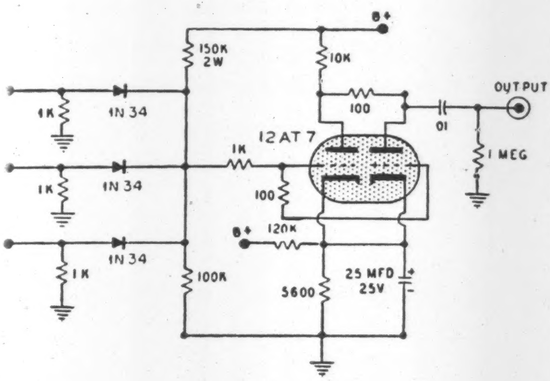

R10
*24K 2W
0.01 3kv
LIGHT TIGHT SHIELDS
R6
R7
8200 2W ea
R8
R9
5μf 2kv
R2
R3
10K 2W ea
R4
R5
1 Meg 2W
5μf 2kv
15h
15h
5μf 2kv
0.01 3kv
10mh SHIELDED
10mh SHIELDED
0.01 3kv
OB2
OA2
5651
0.01 3kv
S3 SWITCH
3 POLE 3 POSITION
OUTPUT
WESTON 741
0-100μa METER
0-1kv SCALE
10 Meg 1W
1.2 Meg 1W
FINE
R13
50K
S2 SWITCH
2 DECK, 1 POLE, 11 POSITIONS
COARSE
1 Meg 1/2 W
R11
*24K 2W
T1
UTC S41
NE 51 ASSEMBLY
S1
DPST
TOGGLE
SWITCH
2A
2A
GE 3x983
115v 60~

*SELECT VALUE SO THAT CURRENT THROUGH 5651 STRING IS 3 TO 3.5ma WITH NO LOAD AT MAXIMUM A.C. INPUT

CIRCUITRY

The circuit is the heart of all electronics. Here are three more basic and interesting circuits. Unless marked, resistors are in ohms, capacitors in microfarads.

TRIPLE-COINCIDENCE CIRCUIT



This coincidence circuit produces an output pulse only hen three input pulses arrive simultaneously. It was sed in a fast-neutron spectrometer.

The tube (a 12AT7 with both halves in parallel) maintained in a normally cut-off state by cathode bias btained from the 120K-5.6K divider. Grids of 12AT7 re connected to a positive voltage via another divider B+, but conduction of the three 1N34 diodes holds the rids at a potential of 1-volt positive or less. Hence tube normally nonconducting. An input pulse of 10 to 15 lts positive at any one of the three inputs will cut off at diode by raising its cathode potential above its anode. onduction of any one of the diodes, however, is sufficit to hold the grids well below the 12AT7 cathode pontial; therefore, the tube remains nonconducting until three diodes are cut off. However, when three positive put pulses arrive at the same time, the three diodes e simultaneously made nonconducting, and the potential the 12AT7 grids rises (until limited by grid current slightly above cathode potential) because of voltage vider to B+. Positive-going triple-coincidence pulses the grids produce a larger negative-going pulse at the tput. Low-impedance drivers are needed to supply the puts; circuit shown was driven from cathode followers.

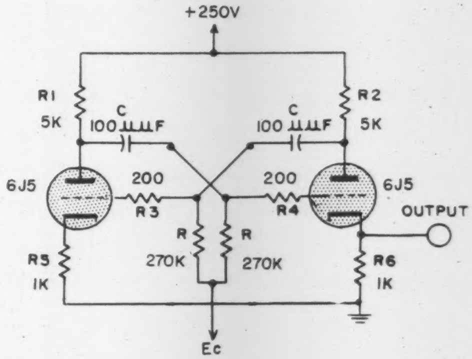
Inputs: Positive pulses, 10 to 15 v.

Output: Negative-going pulse, 125 v, duration same shortest input pulse.

B Supply: 150 v dc; current drain—2.2 ma normally, 14 ma during coincidence.

Source: R. G. Cochran, Pennsylvania State University, University Park, Pa., and K. M. Henry, Oak Ridge National Laboratory, Oak Ridge, Tenn.; also, *Review of Scientific Instruments*, August, 1955.

WIDE-RANGE (20-90 KC) MULTIVIBRATOR



Variation of the positive grid bias of this free-running multivibrator produces wide frequency changes with good linearity.

The circuit differs little in appearance from the conventional multivibrator; addition of grid resistors R3 and R4 and cathode resistors R5 and R6 are the only differences. The cathode resistors R5 and R6 may be omitted; best linearity was obtained with the value shown. Resistors R3 and R4 were found necessary to suppress possible parasitic oscillations in the grid circuit.

Variation of the control voltage E_c from 25 to 250 v dc produces a nearly linear frequency change from 20 kc to 90 kc. Over the range 37-70 kc, maximum departure from linearity was found to be less than ± 200 cps. When the cathode resistors were eliminated, frequency change was 10-60 kc with some deterioration in linearity.

As frequency depends also on heater and plate supply voltages, variations in these must be either compensated for or regulated to acceptable limits.

Frequency *range* may be varied by changing the values of capacitors C or the resistors R. At a given value of E_c, frequency is inversely proportional to the product RC. For smaller RC values, frequency will be limited by tube and stray capacitances.

Control voltage, E_c: 25 to 250 v dc.

Frequency change: 20 to 90 kc.

Output: 30 v peak to peak, approximates a square wave.

Output impedance: Less than 500 ohms.

Input impedance, to control voltage: 270K ohms.

B Supply: 250 v dc at 30 ma.

Source: Sidney Bertram, EE Dept, Ohio State University, Columbus, Ohio; also *Proceedings of the IRE*, Feb. 1948.

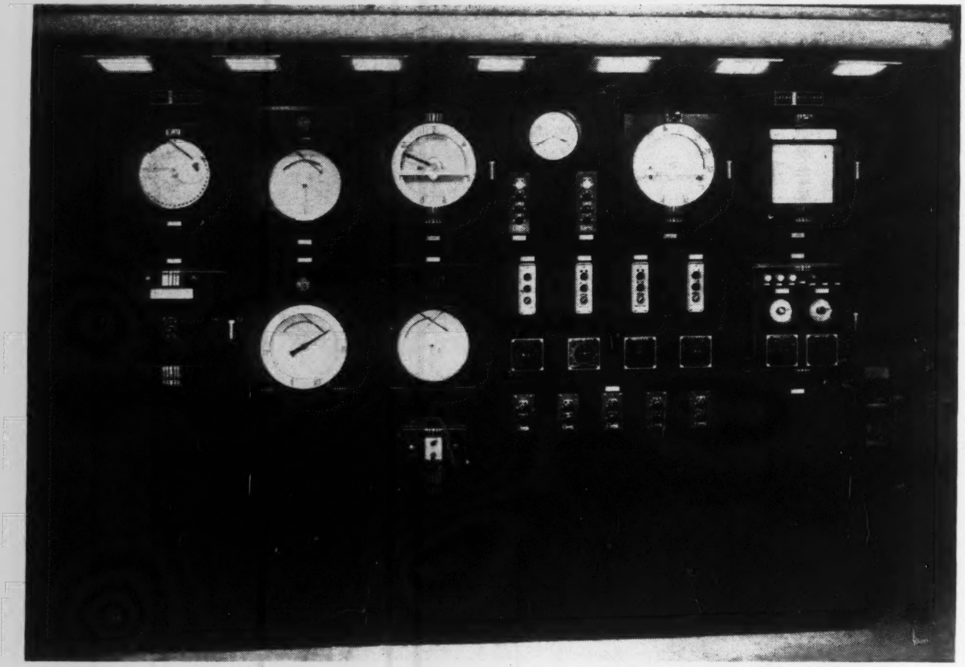


Fig. 1. Instrument panel for Algoma's open-hearth furnace is a cubicle with an asbestos curtain for splash protection. It accommodates instruments and controls for furnace pressure, combustion and BTU input, and automatic reversal.

Electric Control of Open Hearths

Control of a modern open-hearth furnace requires inter-related control of furnace pressure, roof temperature, fuel-air ratio, oil-steam ratio, oil-gas ratio, total BTU input, and furnace reversal. Here is a clear analysis of a modern system based on electric control.

A. K. BAYLES and **D. H. STANTON**
Algoma Steel Corp., Ltd.

A RECENT expansion program at Algoma included the addition of two 330-ton open-hearth furnaces to No. 2 Shop, which already had four 165-ton furnaces.

Description of Furnaces

The new furnaces have basic ends, basic front walls and divided uptakes, and hearth areas of 1,103 sq. ft. Combustion air and draft are supplied by a Morgan Isley system. The primary checkers have a volume of 11,300 cu ft. The Isley or secondary checkers are vertical and have a volume of 2,360 cu ft. Fuels available are fuel oil (with steam atomization) and coke-oven gas. Oil can be fired alone or mixed with coke-oven gas. Combustion air limits the firing rate to 135 million BTU/hour.

Fuel oil is pumped to the shop at 185 psig and 130°F. It is then heated under the control of a recording Viscorator (viscosity recorder) to a viscosity of 150 SSU. Saturated steam for atomizing is available at 200 psig. Coke-oven gas is generally available at about 3-psig pressure. To maintain coke-oven-gas pressure for the rest of the plant, the four 165-ton furnaces are equipped with gas-oil switching control; depending on the variations of pressure in the plant gas main, the flow to the furnaces is changed by a locally mounted controller and the oil flow is automatically adjusted to maintain the total fuel input. When the four smaller furnaces are off and the gas flow and pressure decreases, Vaporstats (low-pressure bellows-actuated pressure controllers) on the two 330-ton furnaces close the gas valves, completely shutting off the gas to these furnaces.

Control System

One of the chief functions of instrumentation is to enable the operator to duplicate conditions which re-

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Presented at Conference on Instrumentation for the Iron & Steel Industry, Pittsburgh, 1955.

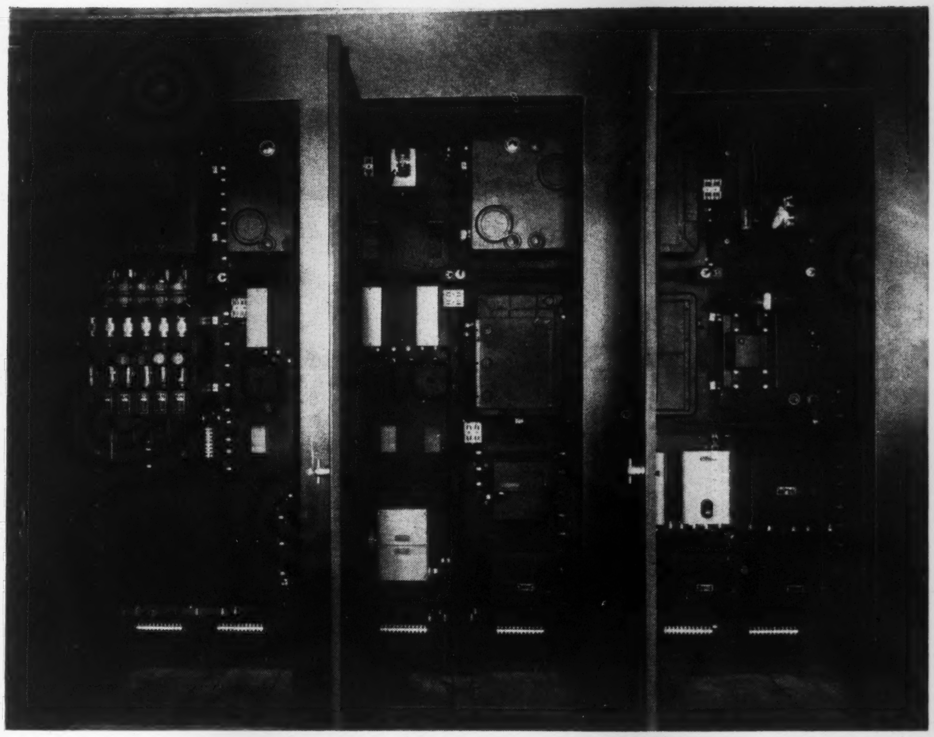


Fig. 2. Rear view shows access doors and neatness of electrical control system.

sulted in previous successful production, as well as to have a record of the controlled variables. Control features which had proved successful on the smaller furnaces, plus modifications considered desirable from experience, resulted in the following list of nine basic instrumentation elements:

1. Furnace-pressure control.
2. Automatic reversal with selector switch by
   - (a) Time.
   - (b) Checker temperature difference.
   - (c) Time or temperature difference.
   - (d) Push button.
   - (e) Block heat.
3. Provisions for manual reversal of furnace.
4. Roof-temperature control.
5. Fuel-air ratio control.
6. Oil-steam ratio control.
7. Oil-gas ratio control.
8. Total BTU-input control.
9. Flowmeters recording fuel oil, atomizing steam, coke-oven gas, and combustion air.

Factors considered in selection of the equipment included (1) simplicity of operation for the first helper, (2) reliability and ease of maintenance along with components familiar to our repairmen, (3) difficulties with pneumatic controls in exposed locations during the winter when temperatures at the panelboards go below zero, (4) uniformity of instruments and controls with existing equipment, and (5) space limitations. These factors led to the decision to use an electric control system with the exception of pneumatic operation of the valves used to reverse the oil, steam, and gas. (Isley systems are designed with air-cylinder-operated reversing valves.)

Leeds and Northrup furnished the complete instrument panel and control equipment, using 3 Bailey flowmeters (2 with totalizers), in addition to their own instruments, to meet the requirements.

Panelboard Instrumentation

All controllers and recorders are mounted on a cubical-type panel (Figs. 1 and 2) 10′ long, 7′ high and 2½′ deep, with three access doors in the back. The panel is 38 feet from the furnace; the charging crane clearance is 3 feet. An asbestos curtain on a roller over the lighting canopy was added for protection from accidental spill-outs. This feature has proved its worth on several occasions.

The equipment is divided into three general groups: Furnace pressure, combustion control, and furnace reversal.

Furnace-Pressure Control:

Furnace-pressure recorder is at top left in Fig. 1, above the controller. The controller has a manual-to-automatic selector switch, open-and-close push buttons, and a control-point setter. The controller has proportional plus reset action and is fast acting. Signal lights indicate the direction of the drive action. The control system will be discussed in detail after a brief review of the entire system.

Combustion and BTU-input Control:

In the center of the panel are the controllers for fuel flow rates and flame characteristics. The primary functions of this group are (1) to set the firing rate desired, (2) to maintain this firing rate under the control of the roof temperature, (3) to maintain any gas-to-oil ratio,

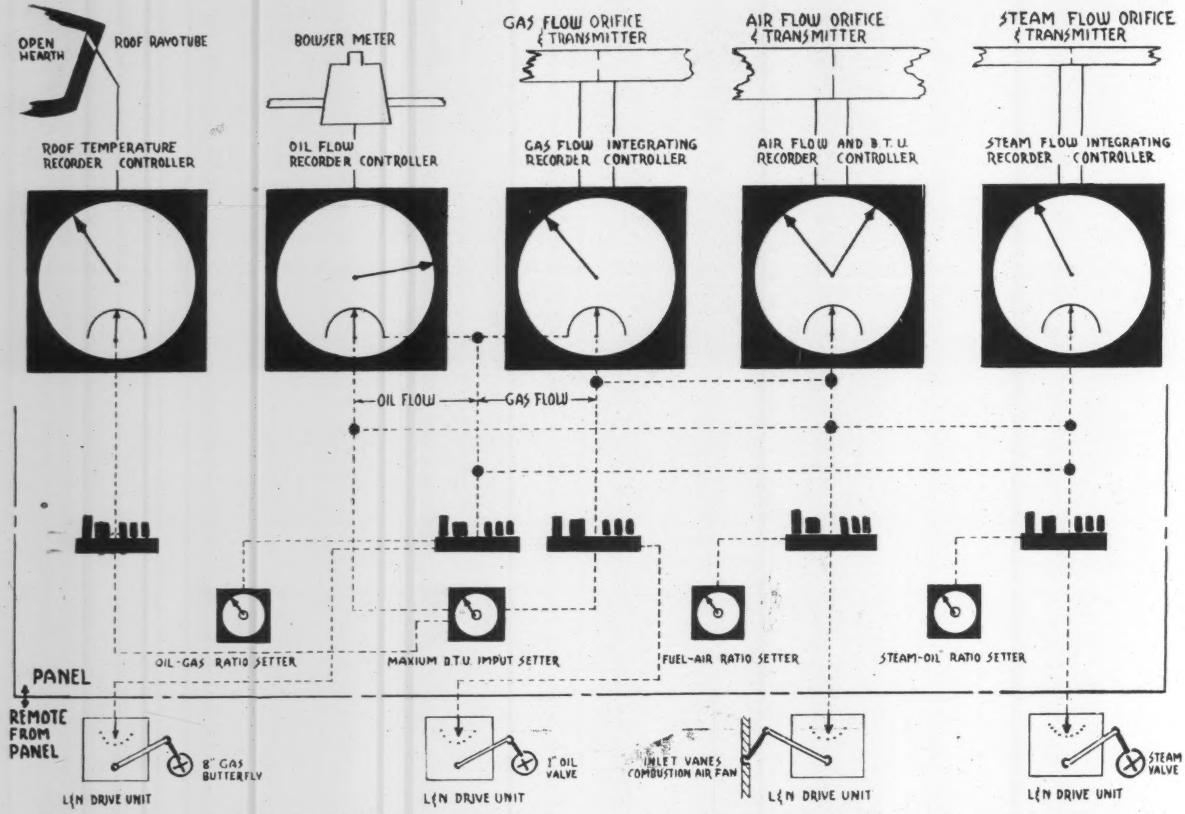

OPEN HEARTH
ROOF RAYOTUBE
BOWSER METER
GAS FLOW ORIFICE & TRANSMITTER
AIR FLOW ORIFICE & TRANSMITTER
STEAM FLOW ORIFICE & TRANSMITTER
ROOF TEMPERATURE RECORDER CONTROLLER
OIL FLOW RECORDER CONTROLLER
GAS FLOW INTEGRATING RECORDER CONTROLLER
AIR FLOW AND B.T.U. RECORDER CONTROLLER
STEAM FLOW INTEGRATING RECORDER CONTROLLER
OIL FLOW
GAS FLOW
OIL-GAS RATIO SETTER
MAXIUM B.T.U. IMPUT SETTER
FUEL-AIR RATIO SETTER
STEAM-OIL RATIO SETTER
PANEL
REMOTE FROM PANEL
8" GAS BUTTERFLY
L&N DRIVE UNIT
1" OIL VALVE
L&N DRIVE UNIT
INLET VANES COMBUSTION AIR FAN
L&N DRIVE UNIT
STEAM VALVE
L&N DRIVE UNIT

Fig. 3. Combustion and BTU-input control system. Basic elements are slidewires in bridge circuits. Each drive unit has its slidewire, as does each recorder-controller. Slidewires are parts of self-balancing bridge circuits.

(4) to maintain a set steam-to-oil ratio, and (5) to totalize the combustion-air requirements and maintain a preset air-to-fuel ratio.

Flow of oil, gas, steam and combustion air are metered and transmitted electrically to their respective receivers on the panelboard.

A two-pen receiver records and indicates air flow and total BTU input to the furnace. The large BTU indicator is provided for the convenience of the first helper. The chart on this instrument has a 0-200 scale, representing 0-2,000,000 CFM (for the air pen) and 0-200,000,000 BTU's/hour (for the BTU pen). This arrangement provides a convenient means for recording the air-fuel ratio.

There are four manual-automatic selector switches with push buttons for the drive units on the oil, gas, steam and air flow valves.

The four control knobs (right of center) are ratio setters. The first one on the left is for maximum BTU input, calibrated 0-175 x 106 BTU. The second one, for gas/oil ratio, is calibrated in percent, from 0-100; it sets the percentage of coke-oven gas for firing. The third one is the steam/oil ratio setter, calibrated 1.5 to 6 lb/Imp. gal. The last one is the air/fuel setter. It is calibrated from 50% deficiency to 30% excess air.

The roof-temperature controller, to the right of the clock, has an external control-point setter.

In the center section, below the clock, there are two start-stop switches for the combustion-air and ejection-air fans. Below the ratio setters are the five door switches.

Furnace Reversal Control:

The reversal control equipment provides either push button or automatic reversal of the furnace firing. The reversal-control relay box is mounted on the right side of the panel, below the checker-temperature recorder. The row of lights across the top indicate the fuel, steam, and damper sequences during reversal. The center light shows when the selector switch is on push-button reversal, and the light directly below, when the selector is at Block Heat. (Block Heat and other combustion control actions will be described in detail after this brief review of system elements.)

The two timers on the relay box allow independent time settings for each end of the furnace. The selector switch on the left has five positions:
1—Time; 2—Temperature difference; 3—Time or temperature difference; 4—Push button; 5—Block heat.

The right-hand knob is for push-button reversal to West or East, and is spring returned to center. The furnace thus can be reversed at any time whether the selector switch is on time, temperature, or push button.

Above the reversal box is the checker temperature-difference controller, a strip-chart instrument with a single-pen recording two temperatures. It first senses the temperature at one end for 10 seconds, then swings to the other for 50 seconds, compares the temperature difference between the two with that set by the control pointer on the top scale, and records it. This can also be used to start the reversal. The set point knob for high-temperature reversal is inside the instrument and cannot be changed by the operator.

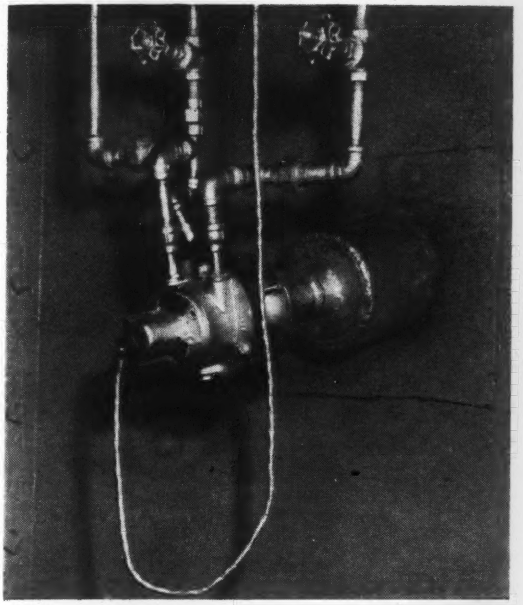


Fig. 4. Radiation pyrometers have air purge to keep ubes clear. They are the primary elements for temperaure-difference controllers.

Operation of Pressure-Control System

Pressure impulse lines from the furnace run to the ontroller diaphragm, positioning a contact on a slidevire. The slidewire is part of a bridge-type controlciruit. When the furnace pressure is in balance with its et point, the slidewire contact is in the electrical center, ınd no control action takes place. Any deviation from he control point is detected immediately and the drive ınit on the ejector-air fan louvres is actuated to change he air flow to the ejector, thereby increasing or dereasing draft on the furnace until furnace pressure is t control point and the circuit is in balance (Fig. 7).

The furnace pressure control is interlocked with the urnace reversal unit. The ejector air fan louvres are pened at each reversal, whereby draft is increased and urging speeded up.

Operation of Combustion-Control and BTU-Input-Control System

A diagrammatic layout of all the combustion-control ımponents is shown in Fig. 3. Primary elements for mperature and flow are indicated at the top. The conitions desired are set up by the four setters (oil/gas ıtio, maximum BTU input, fuel/air ratio, steam/oil ıtio) and the control relays adjust the drive units unl the primary elements position their respective slideires to balance the circuits.

The entire control system is based on the balancing r slidewires in bridge circuits. As shown in Fig. 3, the ive units for the gas, oil, air, and steam lines contain idewires, as do the controllers for roof temperature, oil ow, gas flow, air flow and BTU controller, and steam ow. These slidewires are arranged in appropriate ridge-type circuits whose set points are controlled by ıe four setters shown—(1) oil/gas ratio, (2) maximum TU input, (3) fuel/air ratio, and steam/oil ratio. hese setters feed voltage to the relay amplifiers shown, which are essentially polarity-sensing devices which actuate the drive units.

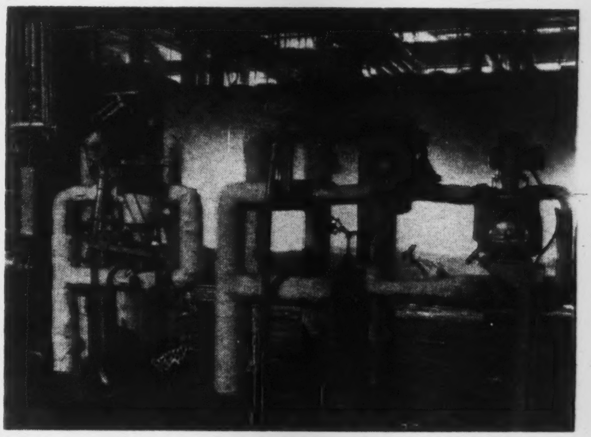


Fig. 5. Identical L&N drive units operate the reversing valves at the reversing stand. Oil and steam lines are shown, with the positive-displacement-type oil meter and electrical transmitter shown at right.

The gas/oil ratio setter sets the percentage of coke-oven gas in the total fuel fired. The gas-flow slidewire is operated by the gas flowmeter, and if the gas is not available to balance its assigned portion of the fuel demand, the condition is detected by the oil-flow relay, which will drive open the oil-flow valve until the oil-flow slidewire brings the circuit to a null balance.

The air/fuel ratio control uses the oil-flow slidewire and the gas-flow slidewire in series to form a bridge with the air-flow slidewire, and the relay operates the drive unit on the combustion-air fan louvres to position the air-flow recorder slidewire and bring the circuit to balance. When either the oil flow or gas flow changes, the relay detects the change and the drive operates to restore the balance. Only a portion of the voltage representing the gas flow is used in this circuit. A rheostat in the circuit allows adjustment for the different air requirements per BTU of the fuels used. The air/fuel ratio setter adjusts the voltage range of the air-flow slidewire, enabling the operator to have an excess or deficiency of air.

The steam/oil ratio control senses the oil flow, and the control relay operates the steam valve drive unit until the steam-flow slidewire balances the circuit.

The roof-temperature controller operates through a P.A.T. (position adjusting type) electric control unit to position a motorized slidewire controlling the total BTU input. The slidewire unit is mounted below the Bailey steam meter in the center of the panelboard in Fig. 1. It has a manual-automatic selector switch with positioning dial on the front of the door to allow manual positioning of the motorized slidewire. The primary element of the roof-temperature controller is a radiation pyrometer. It is mounted on the rear wall of the furnace for direct sighting onto the furnace roof.

When the max. BTU setter on the board is set by the first helper, the roof-temperature controller can reduce this setting in order to maintain the roof temperature at the control point, but the controller cannot increase it beyond the maximum set.

The BTU totalizing circuit for the BTU recorder is separate. A series bridge circuit is used, consisting of a slidewire in each of the fuel-flow recorders and the measuring slidewire in the BTU recorder.

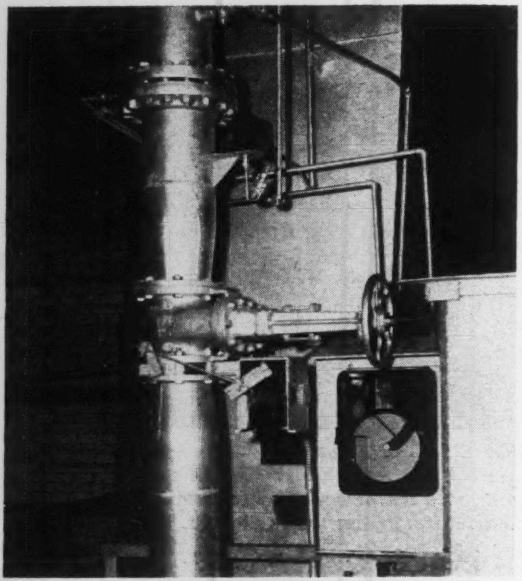


Fig. 6. Gas line to furnace. Flow is metered by an orifice-meter with transmitter (at top of line). Immediately below the manual shut-off gate valve is butterfly control valve with electric drive unit. Vaporstat, which actuates gas shut-off in event of low gas pressure, is just below the orifice.

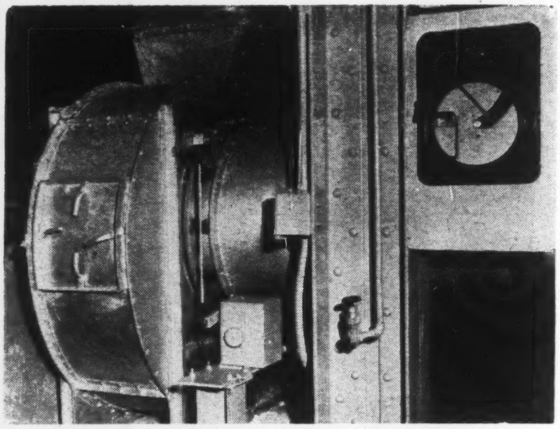


Fig. 7. Air-fan louvres (with their drive unit) and air-flow transmitter form part of the air control system.

Control action, initiated by the roof-temperature controller, causes all five drive units (the four shown in Fig. 3 plus the drive unit on the BTU-input setter, which is not shown in Fig. 3) to operate through their respective control units. Sensitivity, proportional band, and reset adjustments allow any demand change to be handled quickly and smoothly by these drive units.

Piping was laid out with provisions for manual reversal of oil, steam and gas. As the throat dampers and air gates in the Isley system are operated by air cylinders, compressed air is required for any furnace reversal. In the event of reversal unit failure, the valves positioning the Isley dampers can be operated manually.

Block Heat position on the furnace reversal switch is another feature. With the Isley system it is a great convenience to be able, with one motion, to close the throat dampers, shut the fuel off, the air off, etc., to seal the furnace. In each of the methods for control of furnace reversal (except push button and block heat), reversal will take place when either checker chamber reaches a preset high temperature limit, regardless of time or temperature difference. This is done to protect the checkers.

The primary elements for the temperature-difference controller are matched radiation pyrometers in the checkers (Fig. 4). They are sighted on the center line of the checkers on the underside of the fantail about two feet back of the bull nose. A small bleed of compressed air is fed into the sighting tube to keep the tube clear. No other cooling is necessary; weekly cleaning keeps them in good shape.

Regardless of the method used to initiate automatic reversal the same sequence of action takes place. The main features of the reversal sequence are briefly listed:

1. Alarm horn sounds. (This is essential as the injection-air fan and combustion-air fans coupled with throat dampers in the stacks are potentially dangerous.) If the sequence is not correct the furnace will blow at every door. The fuel cannot come on until the throat dampers are in proper position but the hot air blowing from the furnace is liable to endanger anyone near an opening.
2. Circuits open to interrupt automatic control of oil gas, steam and air flow.
3. Reversing valves shut off oil and gas quickly. The steam flow is shut off slowly and comes on quickly at the other end.
4. Ejector-air fan inlet vanes drive open to speed up purging.
5. The four Isley dampers are actuated. (Their individual speeds are controlled by valves on the air cylinders.) Limit switches indicate that the throat dampers are in proper position and silence the alarm horn.
6. The timers start the interlock and purge cycles Purge cycle ends to restore furnace pressure control and allow fuel reversal valves to open slowly Interlock timer times out and restores automatic action to combustion controls.

Reversal is accomplished in less than 12 seconds by this equipment. To achieve a fast smooth reversal, the Isley damper sequence must be carefully adjusted and the fuel flow restored gradually.

The reversal equipment is used continually, in general with the selector switch at time and temperature difference. The flexibility of the system is such that Algoma has never had to resort to hand reversal, even for maintenance work.

Fig. 5 shows the oil and steam piping at the reversing stands. The drive units operating the oil-flow and steam flow control valves are identical. The positive-displacement-type oil meter with its transmitting head can be seen at right.

Fig. 6 shows the gas line to the furnace. The orifice flanges and the flow transmitter can be seen at the top of the line. Below the main shut-off gate valve (manual) is the butterfly flow-control valve and drive unit. The Vaporstat that shuts off the gas during periods of low gas pressure can be seen just below the orifice.

Fig. 7 shows the combustion-air fan and the drive unit which operates the louvres to control the air flow A portion of the inlet Venturi and air-flow transmitter can be seen. Note the locally mounted Bailey flow controller and the fact that all drive units have convenien hand wheels for manual positioning.

Strip-Steel Thickness Control

AN x-ray gage system developed hrough the cooperative efforts of U. S. teel and General Electric constitutes a ew milestone along the road to comletely automatic steel production. The inallation at the Irwin Works of U. S. eel is the first automatic gage control stem with a complete complement of ixiliary inspection and reset functions tegrated with the over-all drive system reduce manual operations to a minium. The tandem cold reduction mill nsists of 5 roll stands and a tension el arranged in a continuous line. so that ip passes successively through the roll inds and is coiled under tension.

For several years it has been customary use an x-ray thickness gage between e last stand and the winding reel to obin a continuous indication of the thickss of the finished strip. However, it is nerally agreed that the principal rean for variation in finished thickness is e variations in thickness of the incomg strip. Since cold reducing renders the eel strip more brittle, addition of a gage tween stands 1 and 2 was logical.

This x-ray gage between stands 1 and (coarse system) operates the screwown motors on stand 1. The desired hickness is set on the x-ray gage mounted etween stands 1 and 2 as a reference ignal. The difference between actual hickness and desired thickness is brought ut of the gage as a deviation or error ignal. This signal is fed into a transistor mplifier system which determines the irection of the error—that is. whether he strip is heavy or light. The resulting olarized signal is then fed into the Amlistat automatic control system controlng screwdown motors.

Several self-policing functions are inorporated in this coarse regulator such automatic "screw reset," "screw dearture indication" and "screw departure mits." The "screw reset" circuit will run e screwdown back to the original setting ade by the operator. The "screw deparre indicator" indicates to the operator w far the screws have departed from s original selected opening. The "screw parture limit" circuit disconnects the tomatic control when preselected limits roll opening are reached.

The coarse gage regulating system is signed to reduce thickness variations. hese small thickness variations are furer reduced by the operation of the verer regulator on stand 5. This fine conol (similar to the coarse regulating stem) controls thickness of the finhed strip over limited range by varyg stand-5 speed and the tension between ands 4 and 5. Accuracies within 0.0001″ an be obtained.

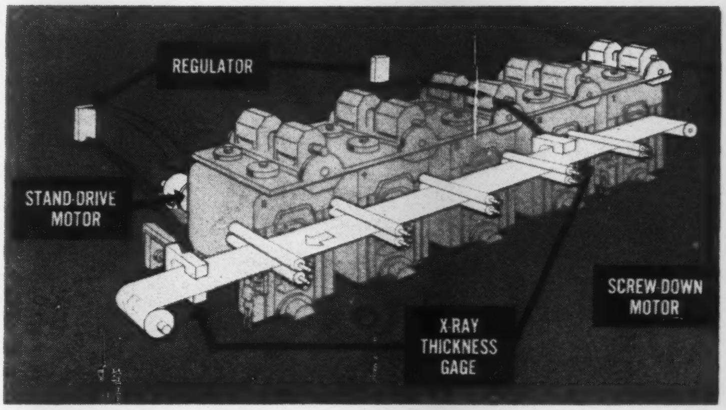


Fig. 1. X-ray gage between stands 1 and 2 controls screwdown motors of stand 1 for coarse control. Second gage on finished strip controls speed of stand 5 and tension between stands 4 and 5 for fine control.

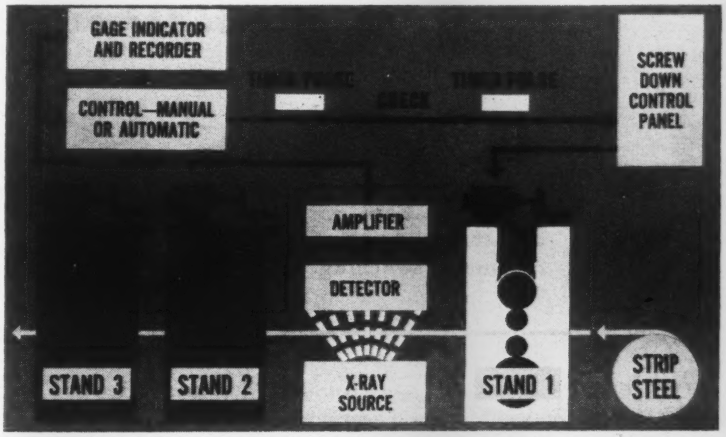


Fig. 2. Elements in coarse control system, which controls screwdown motors of stand 1.

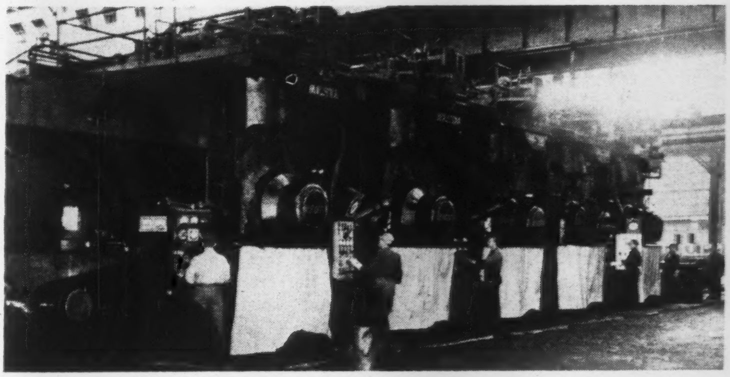


Fig. 3. The 5-stand strip mill in U.S. Steel's Irwin Works, near Pittsburgh. Strip emerges at speeds up to 4000 ft/min. Thickness can be controlled to 0.0001 in.

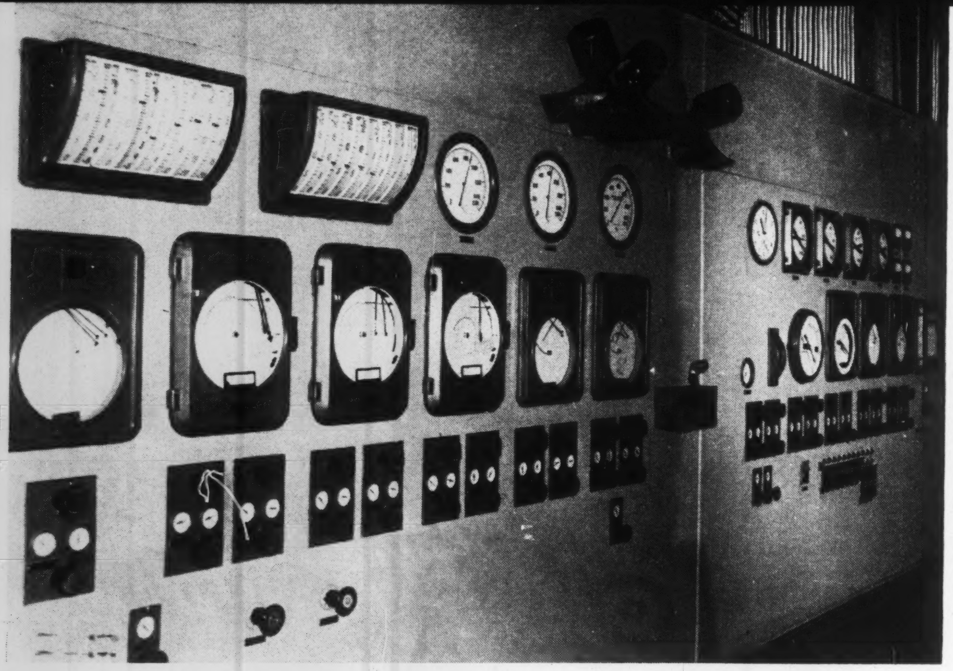


Fig. 1. Panelboard for centralized control of Weirton's new No. 5 boiler unit, rated at 400,000 lb/hr steam at 825 psig and 825°F.

Instrumentation of a New

The new No. 5 Boiler Unit at Weirton Steel has a control system permitting simultaneous use of three fuels. Here is a complete review of all the instrumentation—including control of the fuel flow, the combustion air, and the feedwater system, plus a novel technique for remote manual-automatic switching that results in high-speed automatic-control action.

EXTENSION of blast-furnace facilities at the Weirton Plant of Weirton Steel Company required additional steam-generating facilities. A new steam-generating unit (No. 5) was designed with a capacity of 400,000 lbs of steam per hour at superheater outlet conditions of 825 psig and 825°F. Under normal operating conditions, the supply of blast-furnace gas is expected to be sufficient for a steam output of 325,000 lbs/hr.

An ample supply of blast-furnace gas for fuel, and a desire to reduce air pollution, led to the selection of blast-furnace gas as the primary fuel, with coke-oven gas to be used as the first supplementary fuel up to the limit of availability, and with equipment for burning pulverized coal in event of any deficiency in the existing supply of either blast-furnace or coke-oven gas.

Fig. 1 shows the main control panel, looking north. Recorders are shown for steam, water, blast-furnace gas flow and coke-oven gas flow. Several relay stations of the automatic control system are located below these meters. The control panel is installed opposite the front of the new steam generator, forming a dust-tight room housing the control relays, sedimentation traps and other control units.

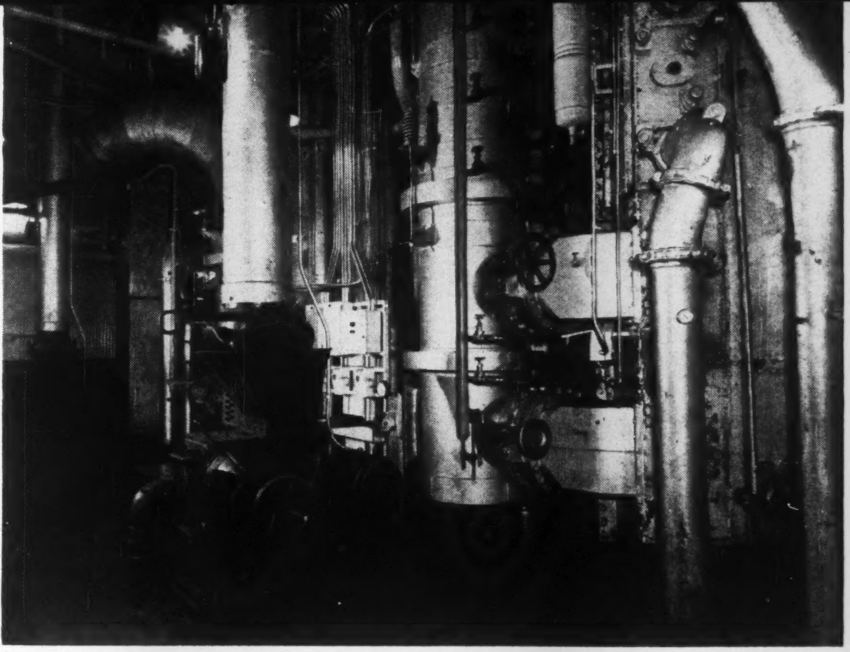
The fuel-blending equipment (Fig. 2) is designed fo simultaneous or separate firing of any combination of th three fuels. The burners are arranged at the corners o the furnace for tangential firing, the burner equipmen at each corner having six compartments. The four uppe compartments are assigned to the burning of pulverize coal and coke-oven gas, using a common supply of combustion air. The two lower compartments at each corne are for blast-furnace gas. These burners take combustio air from a separate branch of the supply system. Pulverized coal as needed is supplied from two Combustio Engineering bowl mills, both motor driven and with combined capacity adequate for full output of the boile when burning pulverized coal only. Coke-oven gas is use on a spillover basis, when and as available.

Combustion Control

Automatic combustion control requires a system fo measurement of the three fuels so that the rate of combustion-air supply can be compensated for varying proportions of the different fuels. In addition, safety feature are required to prevent reduction of pressure in the blast furnace-gas supply below a predetermined minimum, an to prevent introduction of fuel and air through the burners in excess of the capacity of the induced-draft fan t remove the products of combustion.

Presented at Conference on Instrumentation for the Iron & Steel Industry, Pittsburgh, 1955.

Fig. 2. Front of boiler units, which are designed to use blast-furnace gas as the primary fuel, with coke-oven gas as the first supplementary fuel and pulverized coal as second supplementary fuel. The fuel-blending equipment permits simultaneous or separate firing of any combination of the three fuels. Unit in foreground is a bowl mill for pulverizing coal.



Steam-Generating Facility

FRED HICKS

Weirton Steel Company

Experience gained in the operation of the older high-pressure boilers at Weirton resulted in the combustion-control system furnished by Hagan Corporation to this fifth boiler unit.

A functional diagram of the combustion control system is shown in Fig. 3, which will be used as a basis for detailed discussion of the methods used to obtain the desired results.

Primary Control of Blast-furnace Gas

The initial flow of blast-furnace gas is controlled by he *Flow Set Point* shown at top center of Fig. 3A. The ate of blast-furnace-gas firing for the boiler is subject o a second signal (originating at a separate relay at the nain control panel) from the gas flow *Cutback Relay*, which normally repeats the signal and transmits the signal o the separate *Gas Flow Controllers* (top right) for the north and south side burners—if the blast-furnace gas pressure is above a preset minimum value. The signal from the gas flow cutback is modified by the amount indicated as necessary to maintain the blast-furnace gas pressure at or above the necessary minimum value.

As shown near the upper left-hand corner of Fig. 3A, a pressure connection is taken from the blast-furnace gas main to a pressure cutback, which is adjusted to have no effect until the gas pressure reaches a minimum (determined by the demands of other equipment receiving their supply from the same blast-furnace-gas system). The setpoint for this regulator is adjusted from a panel relay, which sends a pneumatic signal to the regulator.

An orifice measurement is made of the flow of blast-furnace gas to the corresponding burners, and the pneumatic signal representing this flow is also connected to the *Gas Flow Controller* (top right). The controller maintains a balance between the flow and the demand by actuating the power unit which operates the gas admission valve.

Control of Combustion Air for the Blast-Furnace-Gas Burners

The combustion-air supply for the blast-furnace-gas burners is adjusted automatically in accordance with the signal representing the flow of blast-furnace gas to the corresponding burners. The gas-flow signal is fed to a *Ratio Adjuster* relay (center right) on the main control panel to permit manual adjustment at the discretion of the operators. The signal from the *Ratio Adjuster* is then used as the indication of the demand for combustion air; this signal is connected to the *Air Flow Controller*. A second signal, resulting from measurement of the rate of air flow, is also connected to this same controller. The controller maintains the rate of flow to satisfy the de-

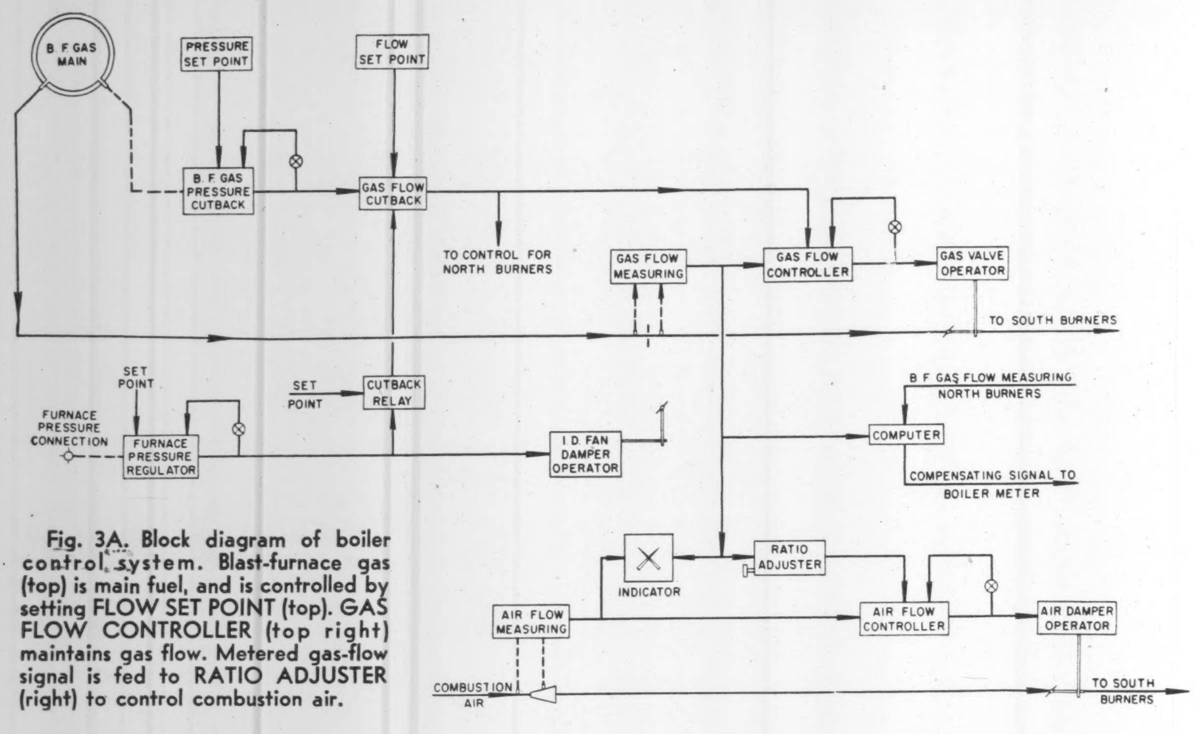

B. F. GAS MAIN
PRESSURE SET POINT
FLOW SET POINT
B. F. GAS PRESSURE CUTBACK
GAS FLOW CUTBACK
TO CONTROL FOR NORTH BURNERS
GAS FLOW MEASURING
GAS FLOW CONTROLLER
GAS VALVE OPERATOR
TO SOUTH BURNERS
SET POINT
FURNACE PRESSURE CONNECTION
FURNACE PRESSURE REGULATOR
SET POINT
CUTBACK RELAY
I. D. FAN DAMPER OPERATOR
B F GAS FLOW MEASURING NORTH BURNERS
COMPUTER
COMPENSATING SIGNAL TO BOILER METER
INDICATOR
RATIO ADJUSTER
AIR FLOW MEASURING
AIR FLOW CONTROLLER
AIR DAMPER OPERATOR
COMBUSTION AIR
TO SOUTH BURNERS

Fig. 3A. Block diagram of boiler control system. Blast-furnace gas (top) is main fuel, and is controlled by setting FLOW SET POINT (top). GAS FLOW CONTROLLER (top right) maintains gas flow. Metered gas-flow signal is fed to RATIO ADJUSTER (right) to control combustion air.

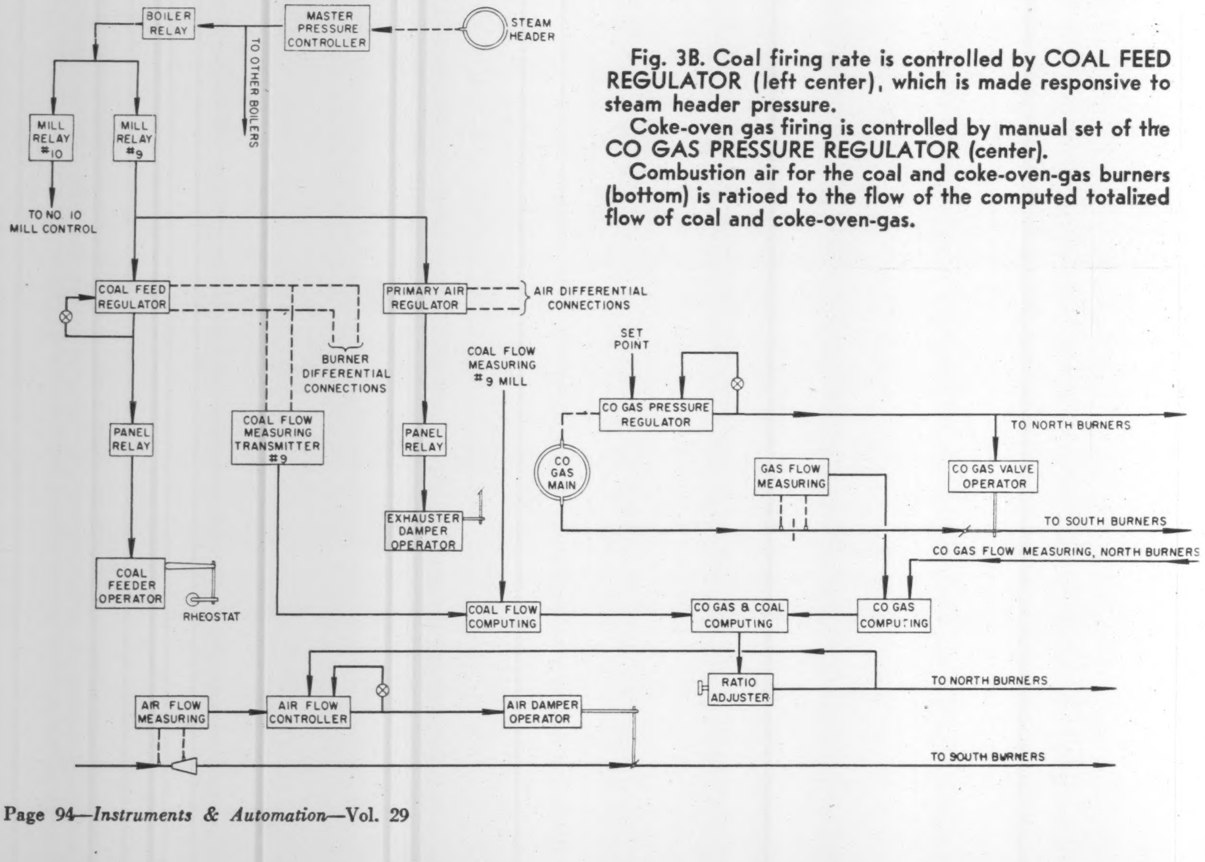

BOILER RELAY
MASTER PRESSURE CONTROLLER
STEAM HEADER
TO OTHER BOILERS
MILL RELAY #10
MILL RELAY #9
TO NO. 10 MILL CONTROL
COAL FEED REGULATOR
PRIMARY AIR REGULATOR
AIR DIFFERENTIAL CONNECTIONS
BURNER DIFFERENTIAL CONNECTIONS
COAL FLOW MEASURING #9 MILL
SET POINT
CO GAS PRESSURE REGULATOR
TO NORTH BURNERS
PANEL RELAY
COAL FLOW MEASURING TRANSMITTER #9
PANEL RELAY
CO GAS MAIN
GAS FLOW MEASURING
CO GAS VALVE OPERATOR
EXHAUSTER DAMPER OPERATOR
TO SOUTH BURNERS
CO GAS FLOW MEASURING, NORTH BURNERS
COAL FEEDER OPERATOR
RHEOSTAT
COAL FLOW COMPUTING
CO GAS & COAL COMPUTING
CO GAS COMPUTING
RATIO ADJUSTER
TO NORTH BURNERS
AIR FLOW MEASURING
AIR FLOW CONTROLLER
AIR DAMPER OPERATOR
TO SOUTH BURNERS

Fig. 3B. Coal firing rate is controlled by COAL FEED REGULATOR (left center), which is made responsive to steam header pressure.

Coke-oven gas firing is controlled by manual set of the CO GAS PRESSURE REGULATOR (center).

Combustion air for the coal and coke-oven-gas burners (bottom) is ratioed to the flow of the computed totalized flow of coal and coke-oven-gas.

mand, this being accomplished by a signal sent from the controller to the double-acting power unit operating the air damper. Metering of the combustion air for the blast-furnace gas utilizes venturi sections fabricated into the two air ducts, each of which feeds two corner burner groups.

Control of Coal Firing Rate

A *Master Pressure Control* unit (Fig. 3B, top), sensing steam header pressure, is available at the main control panel to make automatic adjustments of the coal firing rate. (The signal from a similar but different master pressure control normally adjusts the firing rate of the four older boilers.) A panel relay station accepts the signal from either master pressure control, and also serves as a manual control station at which the operation can set the coal input at a fixed rate.

A separate panel relay is provided for control of the individual pulverizers (bowl mills) in response to the signal initiated either manually or automatically by the boiler relay. The two *Mill Relays* are adjustable for biasing operation of the corresponding pulverizers and for remote manual control of mill output, if required.

The signal from each *Mill Relay* is used to govern the action of the corresponding *Coal Feed Regulator,* which maintains the differential between a point selected at the outlet of the pulverizer exhauster fan and the boiler furnace. The coal feed regulator in turn establishes a controlling signal which is connected through a relay on the main control panel to an operator for the mill feeder *Rheostat.* This controls the feeding of the coal to the pulverizer in step with the desired rate of firing.

Successful operation of this method requires that the rate at which air is drawn through the pulverizer mill by the exhauster must be maintained at a substantially constant value. It has been established by extended experiments that when a mixture of gas and suspended solids passes through a sharp-edged orifice, the pressure drop across the orifice is relatively unaffected by the presence of solids. This principle is used in the primary air control. A *Primary Air Regulator* (left, center), which is designed to maintain a fixed differential across a segmental orifice in the inlet connection of the exhauster, transmits the necessary signal to a diaphragm-type operator which adjusts the position of the exhauster inlet damper, and thereby maintains constant flow of air through the pulverizer.

Individual measuring units are connected in parallel with the two coal feed regulators to measure the differential between the exhauster discharge and the boiler furnace. These two signals are connected to a *Coal Flow Computing Relay,* the output signal of which represents total coal supplied by the pulverizers to the furnace.

Control of Combustion Air for the Coal and Coke-Oven-Gas Burners

Combustion air for the combination coal and coke-oven-gas burners is the result of the measurements of total coal supply and total coke-oven-gas supply, with the totalized signals of each fuel being combined into a final signal indicating total fuel input to the combination burners. This signal is connected through a *Ratio Adjuster* relay (bottom, center) on the control panel, where manual adjustments of the fuel-air ratio may be made by the operators.

The output signal from the ratio-adjusting relay is connected to the *Air Flow Controller* (bottom left), thereby establishing a demand for air which is satisfied on a measured basis by operation of the air dampers at either side of the furnace. Measurement of combustion air for coal and coke-oven gas also utilizes venturi sections fabricated in the air ducts.

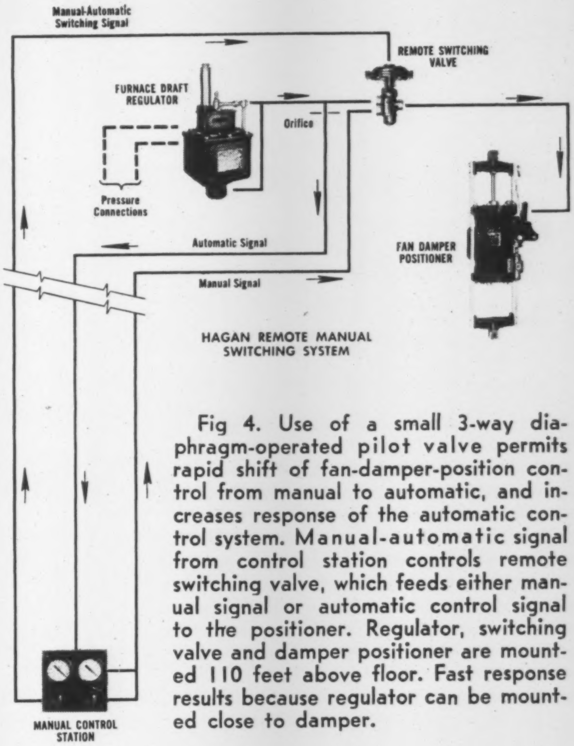


Fig 4. Use of a small 3-way diaphragm-operated pilot valve permits rapid shift of fan-damper-position control from manual to automatic, and increases response of the automatic control system. Manual-automatic signal from control station controls remote switching valve, which feeds either manual signal or automatic control signal to the positioner. Regulator, switching valve and damper positioner are mounted 110 feet above floor. Fast response results because regulator can be mounted close to damper.

Control of Furnace Pressure

A constant furnace-pressure is maintained by a separate *Furnace Pressure Regulator* (Fig. 3A, left), which sends a signal through a panel relay station to the power unit operating the induced-draft fan damper. As the induced-draft fan damper approaches the "wide open" position (indicating that the fan is operating at full capacity) a separate *Cutback Relay* senses the change in signal pressure from the furnace pressure regulator and sends a cutback signal to the gas-flow cutback (top center). This prevents overloading the induced-draft fan, which might result in establishing positive pressure in the boiler furnace.

Remote Switching For Rapid Response

Fig. 4 shows a novel method used for transfer between manual and automatic control of the induced-draft fan damper. The object is to increase the response of the automatic control action—to secure operation of the fan damper as quickly as possible after an indication is established by the furnace-pressure regulator. It is obviously necessary to reduce the lengths of signal transmission tubing between regulator and damper positioner to obtain rapid response.

This is accomplished by connecting the output of the regulator directly to the power unit by means of a diaphragm-operated three-way valve. The manual-automatic transfer valve at the relay station is connected to the diaphragm-operated valve so that during manual operation a signal generated by a relay element at the panel may be used for positioning the damper operator. On automatic operation, the change in transfer valve position trips the diaphragm-operated valve so that the signal

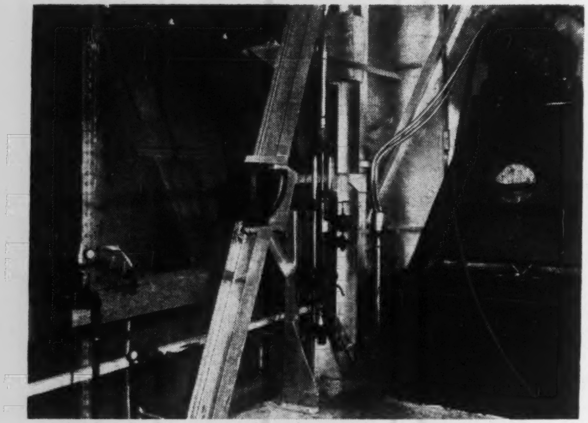


Fig. 5. Fan damper positioner, draft regulator, and small 3-way transfer valve are mounted 110 ft above floor.

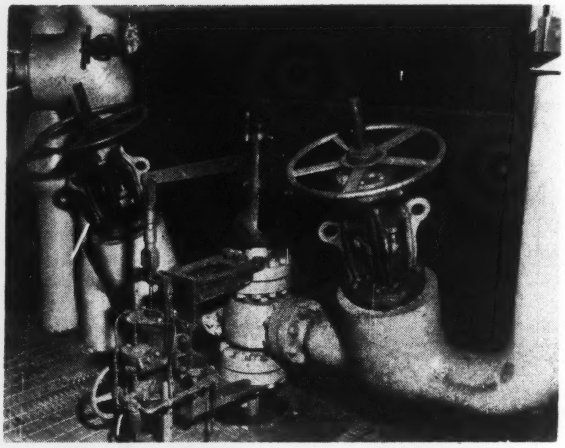


Fig. 7. Large boiler requires large feedwater control valve, shown with cylinder operator.

from the furnace-pressure regulator goes directly to the damper operator. The operator, pilot valve, and regulator are shown in Fig. 5.

Blowdown-Compensated Feedwater Control

The feedwater control system (Fig. 6) is of the three-element type, responding to measurements of boiler-drum water level, steam flow, and feedwater flow. This system includes automatic compensation for blowdown (which has been as high as 20% under adverse river conditions).

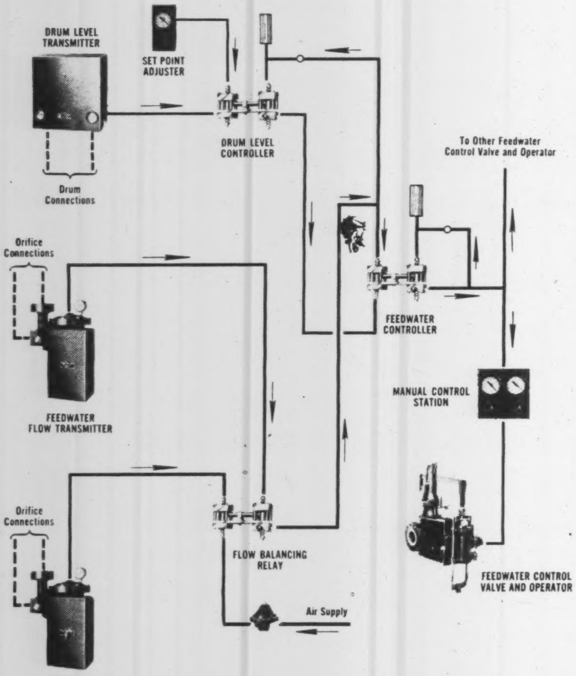


Fig. 6. Three-element feedwater control system responds to drum water level, feedwater flow, and steam flow. Water and steam flows are combined in FLOW BALANCING RELAY to give a signal proportional to difference in these flows; this signal is combined with water level signal in the FEEDWATER CONTROLLER RELAY, which controls the feedwater control valve.

Conventional meter-type transmitters establish the signals indicative of the water level and flow of feedwater and steam. Totalizing relays receive these signals. One totalizer relay sends a signal to indicate changes in water level; a second relay indicates the *difference* between the rate of water input and of steam output. The two output signals are combined in a third relay, a flow regulating totalizer, which sends a control signal to the power unit for the water admission valve.

The effect of a difference between steam flow and water flow, which could be considered as blowdown, is connected to the level totalizer (marked *Drum Level Controller* in Fig. 6) to establish a "neutral" output of the level totalizer when water level is at the desired point. Normally, any changes in the rate of blowdown are reflected in the output signal from the steam-flow—water-flow totalizer (such changes will affect the summation at the flow regulating totalizer and might normally cause changes in water level actually maintained to bring the control system into equilibrium).

By this alternative method, the signal from the drum-level transmitter must exactly equal the level setpoint signal before the flow-regulating totalizer can be in equilibrium, and the drum level must always return to the same value regardless of the fact that water flow will be greater than steam flow because of the blowdown.

A needle valve is located in the blowdown-compensating connection to the level totalizer to permit the system to operate as a standard three-element system during transient changes in load, but resetting at a slower rate to accommodate any permanent deviations in the relation between water flow and steam flow.

A steam pressure reducing and desuperheating station, capable of handling the full capacity of No. 5 Boiler, is also installed to permit the new boiler to deliver steam either to the header in the turbo-generator room or to the main 225-psig steam system of the plant.

It is anticipated that the new steam generator will show an operating efficiency of 79.5% on blast-furnace gas, and 86.3% on coal. For minimizing operating labor and other cost factors, this additional steam capacity has been added to present facilities without removal of any old equipment and without the selection of a site isolated from present operations.

INSTRUMENTS and AUTOMATION Books

Automation in the Iron & Steel Industry. [1956]. Instruments Publishing Company, Pittsburgh 12, Pa. 100 p. paperbound. 8¼ x 11¼. $2.00. A collection of papers presented at Fourth and Fifth Annual Conferences on Instrumentation for the Iron & Steel Industry, 1954 & 1955, sponsored by Pittsburgh Section Instrument Society of America . . . "results in powerful and comprehensive coverage of automation in iron & steel industry, covering all aspects such as blast furnaces, open hearths, rolling mills, etc."

A Palimpset on the Electronic Analog Art, edited by H. M. Paynter. [1955]. Geo. A. Philbrick Researches, Inc., 230 Congress St., Boston, Mass. 270 pages, paper, $1.00. 8½ x 11 in. A collection of reprints of papers and other writings, on the subject of analog computation and simulation, which have been in demand over the past several years. Covers many basic principles and applications that have never been published in book form.

Transistor Electronics, by Lo, Endres, Zawels, Waldhauer, and Cheng. [1955]. Prentice-Hall Publishers, 70 Fifth Ave., N. Y. 11, N. Y. 522 pages. cloth. 6 x 8¾ in. $12.00. Includes both the theory and practice of transistor circuits. This combined work of 5 authorities in the field includes typical circuits, 365 illustrations.

How to Use Test Probes, by Alfred A. Ghirardi and Robert G. Middleton. [C1954]. John F. Rider, New York 13, N. Y. 172 p., unbound. $2.90. 8½ in. Concerned with auxiliary devices, arranged in "probe" form, for extending the application of volt-ohm milliammeters, vacuum-tube voltmeters, and oscilloscopes in trouble shooting and adjustment of circuits.

Electricity and Magnetism, by Ralph P. Winch. [1955]. Prentice-Hall, New York 11, N. Y. 755 p. $7.75. 9¼ in. A one-year course at the sophomore or junior level in college. Presupposes an elementary course in physics and in differential and in integral calculus.

Testing of Hydrometers, by J. C. Hughes. [1954.] National Bureau of Standards. U. S. Government Printing Office, Washington 25, D.C. 10p., unbound. 10c. 10 in. (Circular 555.) Discusses design and construction of hydrometers with special reference to instruments that are to be submitted to the Bureau for testing.

A Practical Manual of Medical and Biological Staining Techniques, by Edward Gurr. [1953]. Interscience Publishers, New York 1, N. Y. 320 p. $4. 9 in. Deals with practical microscopic staining, disregarding theory. Supersedes author's three booklets on "Microscopic Staining Techniques."

Elements of Servomechanism Theory, by George J. Thaler. [1955]. McGraw-Hill Book Co., New York 36, N. Y. 262 p. $7.50. 9¼ in. Brief course for undergraduate instruction. Presents elements of feedback control theory avoiding higher mathematics. Includes analysis of single-loop systems and a brief introduction to multi-loop systems.

Experiments in Electronics and Communication Engineering, by E. H. Schulz, L. T. Anderson and R. M. Leger. Ed. 2. [C1954]. Harper & Brothers, New York 16, N. Y. 342 p. $6. 9½ in. Laboratory manual for college courses in electronics, communication networks, basic radio and television circuits, and transmission systems, including antennas.

Handy-Quick Tolerances, with Quick Methods for Learning Industrial Fractions and Decimal Equivalents, by Alexander Michael. [C1954]. Handy Length Book Co., 3507 17th St., S. W., Canton, Ohio. 92 p., unbound. $2. 5¼ in. Tables with a movable "visualizer" for conversion.

Microwave Spectroscopy, by M. W. P. Strandberg. [1954]. John Wiley & Sons, New York 16, N. Y. 140 p. $2.50. 6¾ in. (Methuen's Monographs on Physical Subjects, [No. 49].) Confined to microwave spectroscopy of *rotating molecules.* Presupposes some familiarity with modern quantum mechanics and matrix methods.

Experimental Electricity for the Beginner, by Leonard R. Crow. Ed. 2. [C1954]. Edwards Brothers, Ann Arbor, Mich. 284 p., unbound. $2.50. 11 in. Simple experiments to be performed with the author's "experimental kit". Book is reproduced from typewritten copy.

Frequency-Response Symposium. [1953]. American Society of Mechanical Engineers, New York 18, N. Y. Various paging, unbound. $5. Collection of 16 advance papers, to be published with discussion and additional papers with title "Theory and Practice of Frequency Response".

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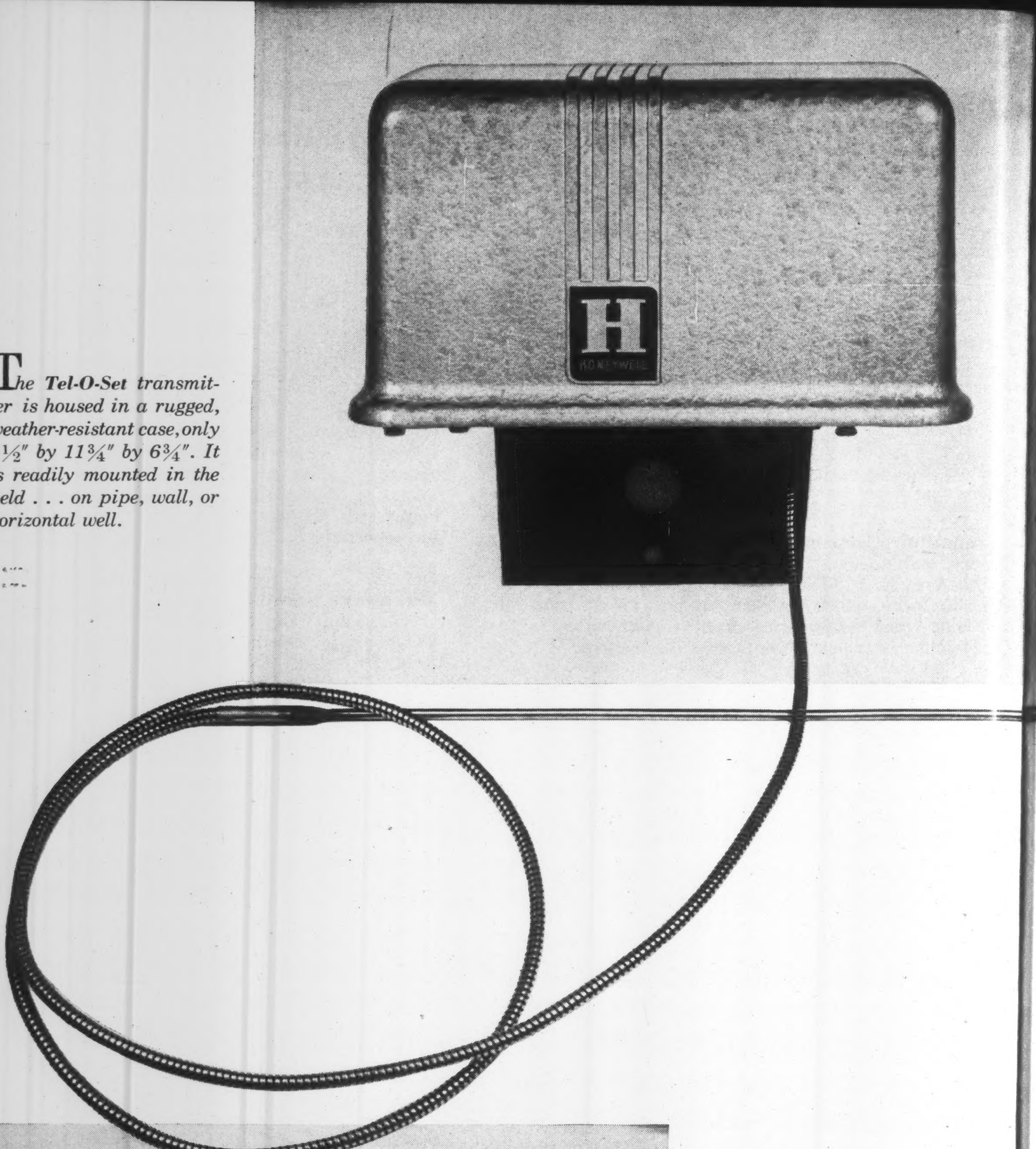
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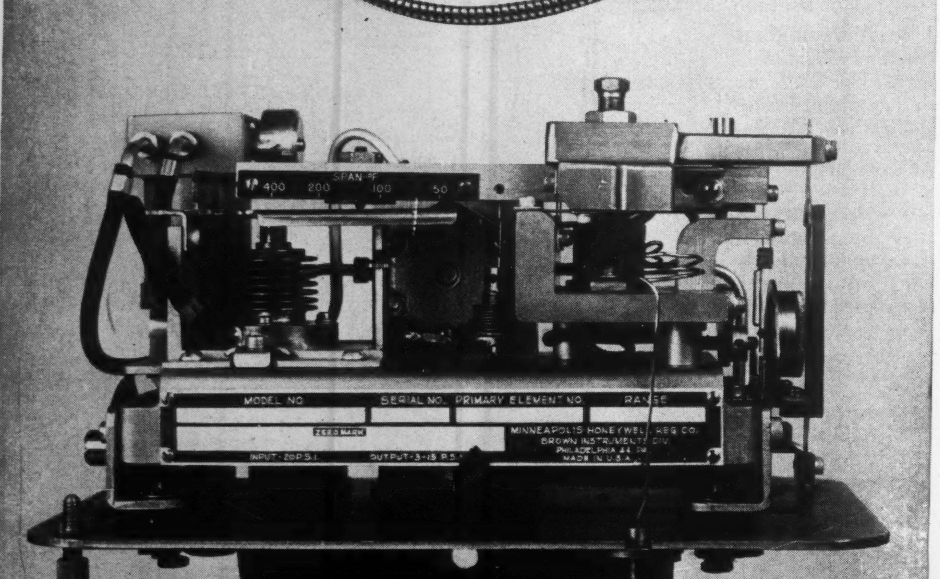
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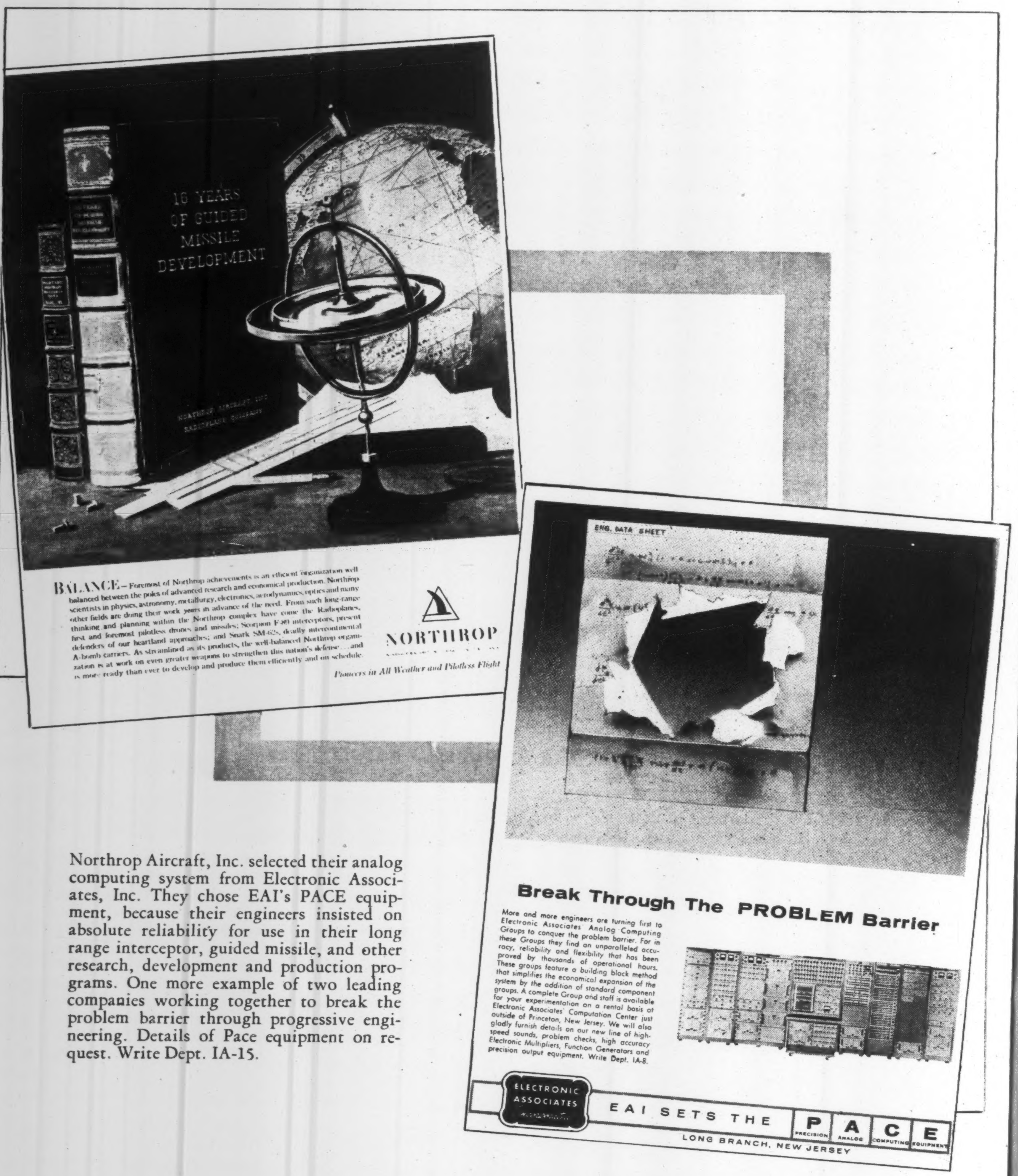

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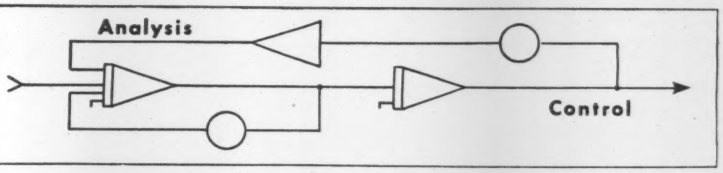
The SIMULATION COUNCIL *Newsletter*



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WE'RE BACK! Of course most of you don't know we've been anywhere—but believe me, we do. Your Ed. and Sec'y flew down to the Bahia de Concepcion area of Baja California, Mexico, then roughed it with only the 55 pounds of gear we each were allowed on the airplane. We slept in caves and on beaches and bounced in the back of trucks over more than 300 miles of roads you wouldn't believe. For days we had to go diving for our food before breakfast or no breakfast—or any other meals, for that matter. But the seafood was plentiful (I got one fish that seemed as big as Suzy with a homemade spear meant for nothing over 2 pounds). And we did have fun, and new and *different* experiences, which right now I would rather write about than computers (and you would probably rather read about), but this is no sportsman's magazine, so—o—o

BITS

This month we have only one Simulation Council meeting to report under "Pieces" because Hal Coleman (Bendix Research Laboratories, Detroit, Mich.) says he is having trouble getting the word on the Midwestern SC meeting in Chicago which he was unable to attend. Your Ed. was there, but without my Sec'y I find that my notes are inadequate, inconsequential, and often irrevelant.* However, Ro Favreau (Electronic Associates, Princeton, N. J.) has done a good job of reporting the Eastern SC meeting, and we are trying a new trick which we hope will add some personal interest: We are printing a picture taken at that meeting in which we identify as many of those mentioned in the writeup as we can.

Under "Info" I have assembled some very miscellaneous information which I find interesting and hope you will.

Finally, just in case, I close with a couple of "Thots" you might enjoy agreeing or disagreeing with. Either way I can *hope* to get your feedback!

---

*A new word I just coined: irrevelant = irrelevant + irreverent, which perfectly describes some of my notes.—Ed.

Pieces

MEETING OF THE EASTERN SIMULATION COUNCIL

by Ro Favreau

The subject of the meeting held at the Glenn L. Martin Company in Baltimore, Maryland on 19 September, 1955, must have been interesting to many because 71 members turned out to learn "*How To Find Out When You Are Right.*" These members, representing 28 different organizations, were well received by the host, Frank Richmond, and the Glenn L. Martin Company. To many of us it was quite an experience to sit in airline seats while learning how we can determine whether or not our aircraft equations are set up correctly.

After preliminary announcements of coming meetings, nominations were made for the Simulation Council positions to be voted on in November.*

Richmond on Computer Checking Techniques

Frank Richmond opened the technical portion of the meeting by reviewing a list of topics suggested for initiating the discussion of computer checking, as follows:

1. Background Discussion
   a. Standards, objectives, criteria of validity
   b. Choice of methods

---

*We have since received word from Ro that the following were elected:
Chairman—FRANK RICHMOND (Glenn L. Martin Co.)
Vice-Chairman—R. R. FAVREAU (Electronic Associates)
Secretary—BERNARD LOVEMAN (Reeves Instrument Corp.)
Treasurer—JULES LEHMANN (Radio Corporation of America)

SIMULATION COUNCIL

Characters attending the Eastern Simulation Council Meeting of Sept. 19 at Glenn L. Martin Co., Baltimore. In the order of their appearance in the script:

1. Ro Favreau (Electronic Associates, and past Sec. and present Vice Chairman of ESC)
2. Frank Richmond (Glenn L. Martin Co., and Chairman of ESC).
3. Bernie Loveman (Reeves, and Sec. of ESC).
4. Jim Follin (APL, and Chairman of the organizational meeting).

Others who can be seen include

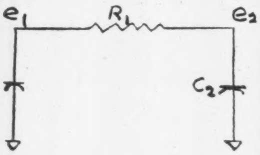
5. H. Wright (National Bureau of Standards)
6. J. Zampino (Glenn L. Martin)
7. J. Strother (RCA Labs)
8. D. Greenberg (David Taylor Model Basin)
9. J. Schmidt (Aberdeen Proving Grounds)

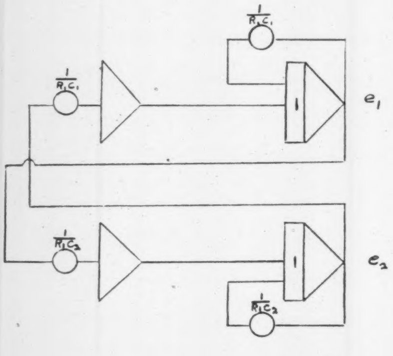
    (1) Independent solutions
    (2) Other methods
2. Checking Linear Systems
    a. Frequency response
    b. Transient response
3. Checking Nonlinear Systems
    a. Supplemented linear techniques
    b. Various substitution checks
    c. Static vs dynamic checking
4. Checking Unstable Systems
    a. Stabilization
    b. Checking
    c. Altering and restoring a computer setup
5. Checking Complex Systems
    a. Initial checking
    b. Checking a new "condition" or configuration
6. Computer Characteristics
    a. Introduction of "extraneous" effects into the problem
    b. Reading out data
    c. Alteration of setup for checking
    d. Malfunctions

Mr. Richmond said that checking is one area where one can most readily improve efficiency of operation. However, adequate checking cannot be made routine; each problem must have its own procedure. Furthermore, he does not feel that a problem should be checked by setting it up on another computer since there are always shorter methods. When another computer is used, and the solutions do not check, the difficulty lies in determining where the error is. Frank believes that there are always procedures which take less time and give better indications of how to trace down errors. He also questioned the validity of a check by parts.

Goodman on Check of Heat Transfer Problem

Mr. Joseph Goodman (Glenn L. Martin Co., Baltimore, Md.) described the checking procedure used on a heat-transfer problem which was solved at Martin. The problem was presented as an electrical analog and is described in the single-section circuits below.





The usual checking procedure was started for this problem, but it soon became involved and time-consuming. So, instead of attempting to check the analog circuit directly, it was decided to go back to the electrical analog and determine how best to check it. This resulted in the following procedure:

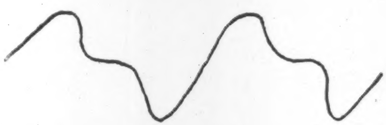
1. With the problem set up with no dissipation terms and no shunt resistors across capacitors, all integrators except the one to be checked were grounded by connecting output to grid. An IC was placed on the non-grounded integrator and the decay time-constant was measured. This procedure was repeated for all the nodes.
2. All grounds were removed and identical IC's were placed on all integrators. The circuit was then checked for no voltage variations in the "operate" condition.
3. With dissipation terms included, procedure 1 was repeated for all nodes.

Mr. Goodman said he believed this was a valid check since: (1) Each element was checked twice, once for zero dissipation, and once with dissipation. (2) Each resistor between nodes was checked twice, once with each connecting node. (3) The system was checked for steady state where any error would show up as a heat flow. (4) Special colored leads were used to ground integrators so the procedure could be made relatively fool-proof. Furthermore, if all leads were not removed, a gross and detectable error would occur.

Questioned, Mr. Goodman said that it took two to three hours to check a 30-capacitor configuration. Some people liked the fact that this check uses time constants which are basically related to the components of the system. Normal measuring errors in determining these time constants could be easily related to problem components and their accuracy. *Dr. Louis Bauer* (Reeves Instrument Corp., New York, N. Y.) questioned the validity of the check, because actually the procedure checked parts. With enough checks one can check all parts but not simultaneously. For a complete check he felt that an independent solution was required—possibly for a digital computer.

Lefferts on Problems with Varying Natural Frequency

Mr. E. Lefferts (Glenn L. Martin Co.) continued the discussion by describing a check devised for those problems in which second-order systems are studied under conditions where the natural frequency must be varied. In this check the natural frequency ω_n is forced to vary in a specific way, namely: $\omega_n = A \cos \omega t$ where $A/\omega = \pi$. This gives a distinctive property to the output wave which is repetitive at twice the frequency:



The general form of the differential equations solved is

$$\ddot{Y} + F'(t)F(t)\dot{Y} + [F(t)]^2Y = 0$$

The check is qualitative, but gives a good indication of small variations in frequency and dynamic operation of multipliers.

Loveman on Problem Check Technique

Bernie Loveman (Reeves Instrument Corp.) next distributed copies of Reeves Technical Article Reprint No. 102*, "Problem Check for Analog Computers"** and discussed the technique used in this new Reeves feature. He said that what they want to check is: (a) Problem coding; (b) Patching; (c) Scale factor potentiometer settings; all with respect to the original equations. He said also that the checking process should indicate what is wrong if an error is indicated; should be easy to use; and should not require any change in patching to perform. The circuit used to obtain this check is shown below.

The procedure followed for the *static check* is to set the problem check potentiometers to a convenient set of values. The voltage at each point in the computer is then calculated from the original equations and correspondence between the machine values and calculated values determined. The outputs of the integrators are now the negative sum of the inputs.

For *dynamic check*, there is an automatic stop at either 1 or 9 seconds, so that the integrator outputs, when the computer is put into "operate," should increase by a value of two or ten times the value determined in the static check. This part of the check created considerable discussion, the final conclusion being that the dynamic check is actually a check on capacitor accuracy. It was also pointed out that networks added externally are not checked—but checks are made up to their inputs, and from their outputs.

Mori on DACL Approach

Hideo Mori (Massachusetts Institute of Technology, Cambridge, Mass.) said that the Dynamic Analysis and Control Laboratory approaches the check procedure from two different viewpoints. They check each part of the circuit with what is essentially a static check, and also have a digital solution run for an over-all check. Special components, like functions of two variables and Euler angle transformations, are checked dynamically, with results usually plotted out. An interesting fact presented was that a digital check for a good 3D problem takes about eight girl-months* on either the IBM equipment or the Whirlwind computer. With respect to accuracy required, he said that three-place agreement was good for static checks, but that this very often must be in the order of 2% or better, depending on the particular problem.

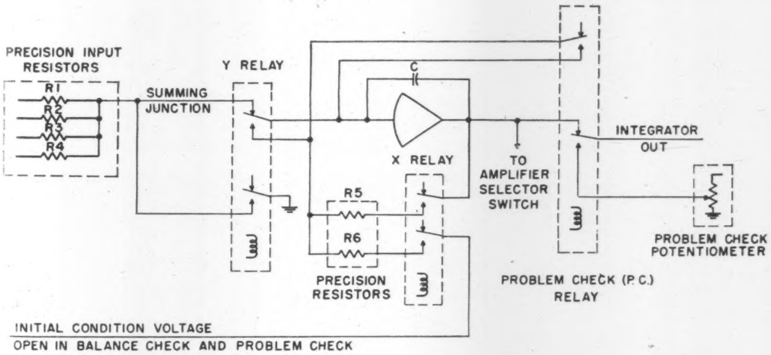

PRECISION INPUT RESISTORS
R1
R2
R3
R4
SUMMING JUNCTION
Y RELAY
C
X RELAY
R5
R6
PRECISION RESISTORS
TO AMPLIFIER SELECTOR SWITCH
INTEGRATOR OUT
PROBLEM CHECK POTENTIOMETER
PROBLEM CHECK (P.C.) RELAY
INITIAL CONDITION VOLTAGE
OPEN IN BALANCE CHECK AND PROBLEM CHECK

TABLE OF INTEGRATOR MODES

RELAY	PROBLEM CHECK STATIC	PROBLEM CK. DYNAMIC		BALANCE CHECK	RESET	OPERATE	HOLD
		OPERATE	HOLD				
X	E	D	D	E	E	D	D
Y	D	D	E	E	E	D	E
P.C.	E	E	E	D	D	D	D

E-ENERGIZED, D-DEENERGIZED

Circuitry Required for Problem Check

Knobeloch on NADC Approach

Dr. Edward Knobeloch (Naval Air Development Center, Johnsville, Pa.) said that they approach checking by breaking their system up into n_1 nonlinear first-order differential equations, n_2 nonlinear second-order differential equations, and n_3 algebraic equations. Checking on any of the above groups may be either static, dynamic, or both. However if n_1, n_2, n_3 are sufficiently large, they felt that it is imperative that a digital check be made also. This is particularly important since there is no assurance that the entire system is correct even though all n_1, n_2, n_3 checks have been made. These part checks do not include cross-coupling. He said that to date all analog computer problems have matched their digital check solution—eventually.

Follin on APL Approach

Jim Follin (Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Md.) indicated that at the Applied Physics Laboratory most checks were of the static type. However, they also perform dynamic checks on certain parts and run frequency-response curves on special networks. They too have found that special techniques are required in special circumstances. For instance, if there are two channels which are supposed to be identical, then a check of this condition can be very helpful and time-saving. One procedure they use is to save the last run of the day and be sure that this can be repeated the next morning. This is a particularly good check on janitorial service!

---

*In California 102's a brew!—Ed.

**Can be obtained from Reeves Instrument Corporation, 215 E. 91st St., New York 28, N. Y.

*Wow!—Ed.

INFORMATION (Without Theory)

By the time you read this the first National Simulation Council Meeting will have taken place, and I hope Suzy and I will have seen many of our old friends and met new ones. Planned for the evening of 19 January in Dallas, Texas, primarily as a "social" to allow members of the Western, Midwestern, Eastern, and Southeastern Councils to meet and get to know each other, there will be no technical talks. However, each of the four Councils plans to have a representative tell something of his group's activities and plans.

* * *

By then the second meeting of the Southeastern Simulation Council will also be a matter of history. Bill Bradley, their Secretary, sent us a program for the full day's meeting, which was arranged by David Prince of the Georgia Institute of Technology* to take place at the Institute on 28 November. They planned four formal and formidable-looking technical papers and a discussion of their Council objectives in the morning, and a joint meeting with the GIT Mathematics Colloquium in the afternoon. Then a tour of the Rich Electronic Computer Center was scheduled, to be followed in the evening by a dinner meeting and a panel discussion, "The Training and Education of Simulation and Computer Engineers".**

This meeting certainly sounds more like a full-fledged technical society than the original concept of the Simulation Councils as informal discussion groups, but that is one of the advantages of our organization (or lack of it); individual chairmen and individual groups can run their meetings as they please. We await Bill's notes with interest to see how their plans turned out.

* * *

Speaking of training computer engineers, we have a letter from *Frank Wagner* (North American Aviation) agreeing with our comments on the subject in the November *Newsletter*, and enclosing a North American Aviation inter-office letter explaining their policy of "open shop" computer operation (in which all engineers who can use computing services are trained to use the computer) as opposed to "closed shop" operation (in which problems are presented to a computing group and solutions are returned to the engineer). Many advantages of the "open shop" are pointed out, but to us it seems that one of the most important is that more people are taught to use these powerful "aids to cerebration."

* * *

Left over from John Stroud's talk on humans as reported in the December *Newsletter* is a trick you might play on anyone you don't like (for instance, that guy up the line who will authorize 250 kilobucks for a test but won't give you 25K for some computing equipment with which you could answer more questions than a dozen tests).

John says that band path of the equilibrium mechanism of the inner ear is of the order of 0.14 to 0.4 cps, and that if other sensory organs pick up motion that the inner ear doesn't, conflicting signals to the brain result. These in turn cause motion sickness.

So, John says, select your victim and have him sit in a revolving chair and lean forward with his head on his knees. Turn him slowly (the exact speed doesn't matter) for one minute, then have him sit erect for one minute while still turning slowly. Repeat this cycle until victim heads for the head. John says it will usually take only two cycles—a very tough character may stand five. Furthermore, he will be sick again every 20 minutes for 24 hours!

OK, you practical jokers, let us know how you make out. (If you are fired, I know where you can get another job—so go ahead. Live dangerously!)

---

[*] Any relation to the Georgia Tech ye Ed. used to know?

[**] Professor Macduff please note.

Computer Events

other events on page 118

You Are Invited

The Chairmen of the various Simulation Councils often receive letters from men who want to come to the Council meetings, and who ask permission to do so. This is not necessary. The Councils are informal groups; all who wish to come may do so at any time; no advance permission is required. Anybody interested in simulation technique is not only cordially invited to attend any of the Simulation Council Meetings but is urged to do so. We need your thoughts. To help you know what to expect, some brief program notes will be included in each calendar item in the future.

Western Joint Computer Conference
Dates: 8-10 February 1956
Place: San Francisco, California

High-Speed Computer Conference
Dates: 14-17 February 1956
Place: Louisiana State University, Baton Rouge, Louisiana For information write Dr. Leon C. Megginson, Department of Business Administration, Louisiana State University.

Western Simulation Council
Date: 8 March 1956
Place: Firestone Tire and Rubber Company, Guided Missile Division, 2525 Firestone Boulevard, Los Angeles, Calif. Time: 1300.

Midwestern Simulation Council
Date: 12 March 1956
Place: Cincinnati Milling Machine Company, Cincinnati 9, Ohio.
Subject: "Mathematical Formulation and Transfer Functions"; Tentative speakers: Larrowe (University of Michigan); Hamer (Electronic Associates); Robinson (Wright Air Development Center) Discussion will emphasize (1) Mathematical formulation or direct formulation? (2) How to set up transfer function most effectively? (3) Are you simulating or computing?

Eastern Simulation Council
Date: 19 March 1956 (tentative)

IRE National Convention
Dates: 19-22 March 1956
Place: New York, N. Y.

ISA and ASME
Dates: 26-27 April 1956
Place: Hotel Bradford, Boston, Mass.
Subject: Conference on Electrical Recording and Controlling Instruments. For information write E. T. Davis, Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Penna.

Eastern Simulation Council
Date: March 23, 1956
Place: Waldorf-Astoria Hotel—New York City
Host: Mid-Century Instrumatic
Subject: Function Generation

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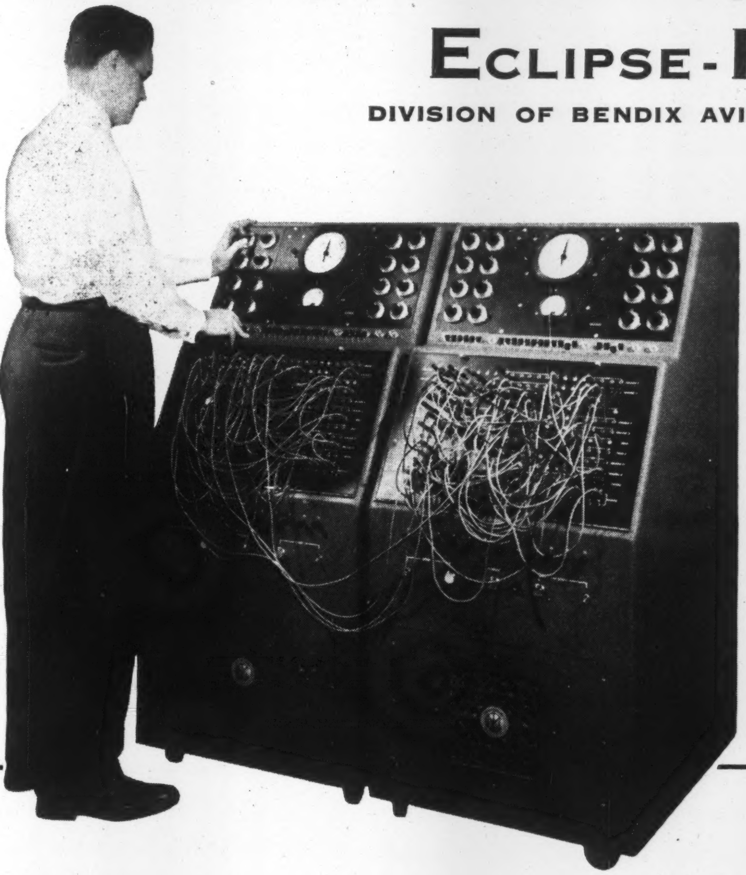

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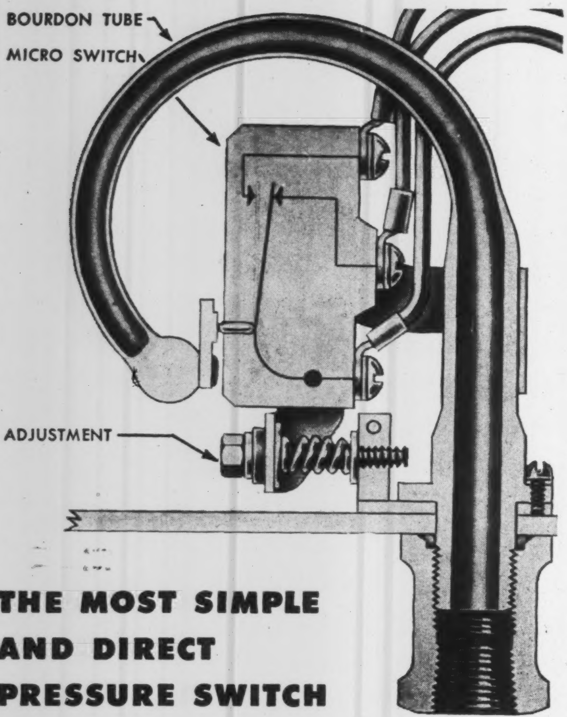
For more information circle **58** on inquiry card.



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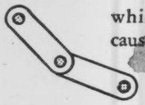

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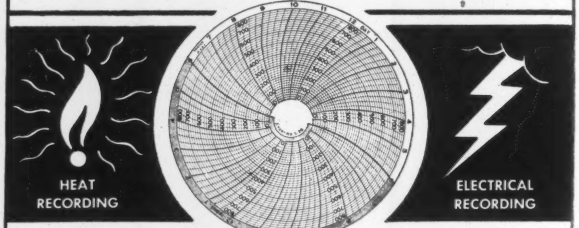

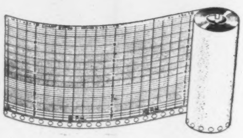

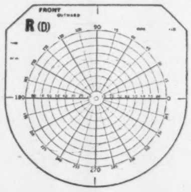

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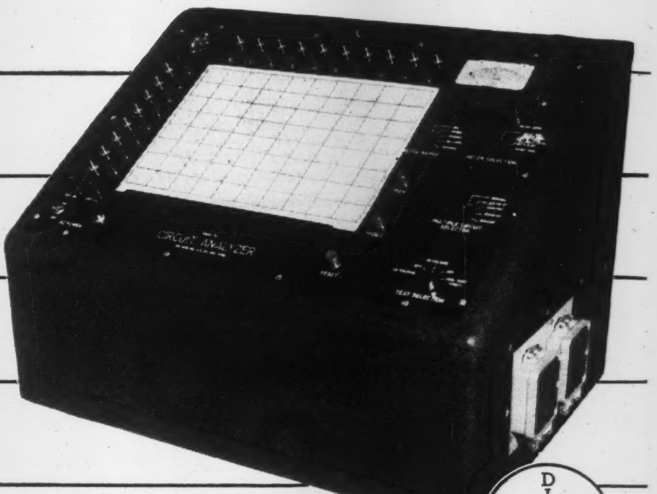

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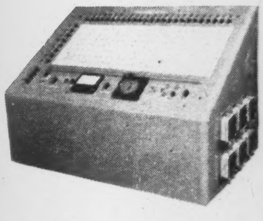

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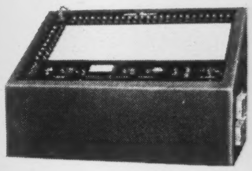

Multiplier Sections

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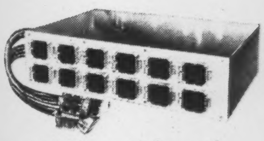

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Journal of the S C M A . . .

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Developments in ORIFICE METER MEASUREMENT

Here is a thorough résumé of the history, basic equations, and existing state of the field of inferential flowmetering with orifices. This contribution to the literature of the field reclarifies perspective and shows the trends in the field.

RICHMOND M. VOILS, JR.,
General Petroleum Corp.

History

RECENT PROGRESS in inferential measurement is but a continuation of the total history of this type of measurement, dating back to the days of *Galileo, Bernoulli* and *Torricelli,* founders of the science of fluid flow through orifices. Little was done commercially with the knowledge that these men contributed to the world of fluid flow until a professor at the Ohio State University, by the name of *S. W. Robinson,* suggested that this knowledge of orifice flow could be used to measure large flows of natural gas which at the time were going unmeasured. This was some seventy years ago. Much has been accomplished in orifice meter measurement since these early beginnings.

More than twenty years after the first measurements were taken near Columbus, Ohio, *Thomas Weymouth* initiated a series of tests for comparisons between flow through orifices and pitot tubes. These tests aroused such interest that the American Society of Mechanical Engineers formed a Flow Meters Committee in 1915, which eight years later published a reference handbook. In the same era, the Fuel Administration section of the Bureau of Mines appealed to the Bureau of Standards for assistance in standardizing conditions of measurements then in service by the Kansas Natural Gas Co. and the Lone Star Gas Co. Because of these and other requests, the Bureau of Standards conducted the Edgewood Arsenal tests. The year after these tests were started the American Gas Association became interested in large flow measurement and started the first of some fourteen tests. Some were conducted under the joint sponsorship of the American Gas Association and the A.S.M.E., some under direct supervision of the Gas Measurement Committee, and some by independent investigators.

February Program: *Saturday, the 18th, Annual Hi-Jinks, the one social event of the year, Rio Hondo Country Club, Downey, Calif.*

In 1933 the joint A.G.A.-A.S.M.E. Committee asked the Bureau of Standards for an analysis and a report on the work accomplished to that date. This analysis was done by *Dr. Buckingham* and *Howard Bean* of the Bureau staff, who developed a series of empirical formulas to cover the flow coefficients for flange, pipe, and vena-contracta taps, based on the accumulated data as presented. The formulas then were presented to *S. R. Beitler* for evaluation. It was Mr. Beitler's opinion that the committee should adopt those equations for flange and pipe taps but, because of unsymmetrical results, it was suggested that a smoother curve be projected for vena-contracta taps. Data for pipe and flange taps were then published as the "Gas Measurement Committee Report #2" on May 6, 1935.

In the same year that the A.G.A. Report No. 2 was published, a joint committee composed of members of the California Natural Gasoline Association, the Pacific Coast Gas Association, and the Southern California Meter

Association, published a bulletin (based on the report) known as "Tentative Standard Procedure for the Measurement of Natural Gas with Orifice Meters," or simply T.S. 353. This bulletin was intended as a recommendation handbook for Pacific Coast Companies employing orifice metering. Base pressure for this and other standards on the Pacific Coast is 14.73 psia, rather than 14.4, as presented by A.G.A. T.S.-353 provided also a simplified method of computation for non-standard pipe and orifice sizes by use of a tabulated ratio of discharge coefficients.

Realizing that increasing use of inferential measurement required simplified method of coefficient calculation, the above three California organizations published in 1941 a new bulletin titled "Tentative Standard Procedure for the Determination of the Corrected Hourly Gas Coefficient (C) used in the Measurement of Natural Gas by Orifice Meter," or T.S. 402. This bulletin was unique in that it provided a simplified standard procedure for the computation of orifice coefficients by field operators. In simplifying the procedure, a consolidation of factors was evolved—that is, the expansion-factor and the Reynolds-Number correction were treated as one factor. This was accomplished through grouping values of β, h/p_2, S, and $\sqrt{hp_2}$. Also, the gravity and temperature factors were combined by tabulation. The bulletin also included deviation factors for pressures up to 500 psig, as developed by the C.N.G.A. about six years before.

As time went on and pressures went up, a second deviation-factor bulletin was compiled by the C.N.G.A. for F_{pv}-factors above 500 psig. At these high pressures it was also necessary to employ another factor for mercury manometers, which is included in the "Tentative Standard Procedure for the Determination of Superexpansibility and Manometer Factors Used in Measurement of Natural Gas by Orifice Meter at Pressures in Excess of 500 psig," published in 1947.

Recent Developments

Since the publication of these bulletins, the gas industry has expanded enormously. With this expansion have come still higher pressures, heavier pipe runs, and higher volumes, resulting in larger tubes. Realizing this, the combined Measurement Committee of the A.S.M.E. and the A.G.A. formed a research group known as NX-4, which was instructed to test the validity of extrapolating existing equations in order to include the larger meter tubes encountered in transport systems. In 1952-1953 this committee conducted tests at Refugio, Texas, and in August, 1953, unanimously agreed that existing formulas were applicable through tubes of 30″ diameter.

With the work accomplished by project NX-4, and with a new supercompressibility study by Beitler completed, it was decided by A.G.A. to bring its Report #2 up to date. The result is Report #3, published early in 1955. The new report, in general, has kept the same material as appeared in Report #2. The only difference is in the expanded tables of pipe sizes, and the rewording of some paragraphs for clarification. Basic coefficient tables now include three and four weights of piping up to 30″. In addition, the new bulletin has been changed to the base pressure of 14.73 psia in place of the old 14.4.

When release of A.G.A.'s Report #3 was pending late in 1954, the California Natural Gasoline Association instructed its Sub-Committee on Fluid Measurement to bring its existing tentative standards up to date with the A.G.A. report. In going over the necessary changes in the two measurement bulletins (T.S. 353 and T.S. 402) it was the Committee's recommendations to combine them into one Gas Measurement Standard. Thus the Pacific Coast Gas Association and the Southern California Meter Association once again formed a cooperative committee to issue a bulletin which is now in the hands of the Editorial Committee of the C.N.G.A.

Basic Equations

The whole orifice-measurement industry is based on the simple equation that the volume (Q) passing any given point is the product of the velocity times the area at that point. When the velocity is affected by an orifice the product must be modified by a coefficient accounting for velocity-of-approach and discharge-constriction factors. The velocity in this equation is Torricelli's free-fall velocity ($v = \sqrt{2gh}$). When we use this equation together with the constant of dimensions and the coefficient, we have the volume $Q = c\sqrt{h}$ (or $c\sqrt{hp}$ for compressible fluids). Therefore, in flow measurement we need know only two or three parameters: the coefficient (which is readily available from bulletins) and the head loss. Each parameter in turn must be considered in terms of the type of fluid flow, of which there are three classes: compressible gases, steam, and liquids.

Gas

Today, nearly all coefficients for compressible gases are based on the works of the A.G.A., which are available in the combined bulletin of the C.N.G.A., S.C.M.A., and P.C.G.A., in the form $C = C_g F_{e2} F_r F_{pv} F_g F_t$. As in most measurement on the West coast, this coefficient is further modified by a factor "M" for the use of square-root charts. Taking each factor in sequence, we find that the uncorrected coefficient C_g is equal to $338.2d^2K_o$ (K_o is the discharge coefficient as calculated from Buckingham and Bean's empirical equation, and the number 338.2 is a consolidation of constants).

The expansion factor, F_{e2}, corrects for the difference in gas densities between the upstream and downstream taps. This factor also is derived from the Buckingham and Bean equations. However, as the original equations were based on an upstream-pressure connection and as most measurements are taken from a downstream tap, the equation must be corrected.

F_r, or Reynolds Number factor, is found as a function of the Reynolds Number β, D, and d, all combined into an empirical equation.

The super-expansibility values under 500 psig currently are tabulated as functions of pressure (F_{pv}), gravity (F_g), and temperature (F_t). Values over 500 psig are determined by critical temperature and pressures values. The gravity and temperature factors are corrections to the gravity of air = 1 at 60°F.

The square-root type of chart (which is in common use today) simplifies computations by changing the general flow equation to a simple multiplication, i.e., $Q = c\sqrt{hp}$ is changed to $Q = C_s h_s P_{s2}$ by the addition of "M," which is equal to $0.01\sqrt{h_R P_R}$, h_R and P_R being the differential and the pressure range, respectively.

Liquid

Liquid coefficients present a different picture. To date, no national standard has been accepted for over-all work. This is all the more remarkable as the original Buckingham and Bean equations were based mainly on water flow. However, a good method of computation is available through the Southern California Meter Association. This method, which is mainly the result of W. L. Cowan's work, is similar in form to the gas formula: i.e., $C = C_L L_G L_T F_R F_M$, which may be modified by M (in this case $M = 0.1\sqrt{h_R}$).

The constant in the expression for C_L after consolidation is 340.1, which makes $C_L = 340.1\ K_o d^2$ (as compared to $C_g = 338.2\ K_o d^2$). Therefore, for any given orifice, $C_L = 1.0056\ C_g$.

L_G and L_T are the gravity and temperature factors, respectively. The reference for L_G is the sp. gr. of water $= 1$ at 60°F; and $L_T = \sqrt{T_c}$ in which T_c is a ratio of the density at flowing temperature to the density at 60°F.

F_R, or Reynolds Number factor, is equal to $1 + \dfrac{(J + B)d}{R}$ in which J and B are values from Buckingham and Bean's coefficients, and the Reynolds Number $R = \dfrac{52.66\ Q_L\ G_{60}}{d\mu}$. The recommended procedure is to first calculate an approximate Reynolds Number using: $Q_L =$ gph at 60°; G_{60} (specific gravity at 60°); d in inches, and the viscosity μ in centipoises. This value for R can then be used in the F_R formula. To facilitate the computation, values of $(J + B)d$ have been plotted against pipe and orifice sizes for both flange and pipe taps in the S.C.M.A. Handbook.

In gas equations over 500 psig, all liquids will approach the density of mercury. Therefore, for mercury-type manometers a manometer factor is necessary; this factor $F_M = \sqrt{1 - \dfrac{G_s}{G_m}}$. For water as the sealing liquid (G_s) and mercury as the manometer liquid (G_m) the factor $F_m = 0.9624$.

Steam

Steam, although a compressible fluid, always has been treated as a separate measurement problem because dimensions are in pounds, and steam *quality* is an important factor. Here again the S.C.M.A. has, with W. L. Cowan's work, a standard for use in computing flow coefficients which are similar to the gas and liquid formulas. In consolidation of constants for steam we find that $C_s = 16.36\ K_o d^2$. Again we can form a relation to the gas formula ($C_g = 338.2\ K_o d^2$) as follows: $C_s = C_g/20.67$.

The standard steam-flow coefficient is $C = S_s F_p F_x \cdot F_{e2} F_R$ (or $C_s F_p F_{su} F_{e2} F_R$) where F_p is the pressure density correction.

$$F_p = 114.4\ W_s/0.2564 P_2$$

where W_s is the saturated steam density at pressure P_2. F_x and F_{su} are corrections for quality (F_{su} is the correction for superheated steam; F_x for saturated steam), each equalling $\sqrt{W_2/W_S}$, where W_2 is the actual density at flowing conditions. The factors F_{e2} and F_R for gases are applicable to any compressible fluid and are so applied in the steam formulas.

Tubes and Meters

With such a store of information on coefficients for sharp-edged orifices, we now can concentrate on the physical properties that are necessary to obtain the other unknown (h) of our basic equation $Q = C\sqrt{hp}$, or $Q = C\sqrt{h}$. The basic elements are the orifice and the tube (or run) in which it is placed. A.G.A. meter tube specifications are adhered to for all fluids. There is no great difference between the new Report #3 and Report #2 except to emphasize the importance of adhering to the tolerances as set forth for all dimensions including the inside pipe surface condition. It is definitely stated that "Inside pipe walls shall not be polished, but shall be as smooth as commercially practicable. When pipe walls are machined or ground, the finish should simulate that of new smooth pipe." Whether or not plastic coating of the inside walls is equivalent to polishing is still under debate —although it appears that plastic coating may give a discrepancy of the same magnitude as polished pipe. Stainless-steel or Monel orifice plates have become more or less standard, because of their resistance to pitting at the place face.

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NX-4 substantiated the accuracy of orifice fittings as an integral part of the meter tube, and did some comparison work between flange and pipe taps. Flange taps have become the preferred type for several reasons. The tube lengths upstream and downstream of the orifice can be made shorter in plant locations in which area is an important factor, and for any given case more tolerance is allowable with flange taps than with pipe taps.

For measuring the pressure drop across the orifice, the *mercury-type manometer* is still the most commonly used instrument. The modern mercury manometer is but an up-to-date version of the original indicating or recording instrument of forty years ago; differences being mainly in materials of construction and stuffing boxes. One recent innovation in upkeep of the pots is the plastic coating of the U tube and pots. Coming up fast in competition with the mercury manometer, however, are two other types of differential gages; the bellows-type or aneroid-manometer, and the force-balance or differential-pressure type of unit. The bellows manometer has become quite prevalent in the field, where contamination of mercury, loss of mercury, or condensation collection over the mercury, has been a problem. These meters are essentially interchangeable with existing mercury meters. Application of the differential pressure cell is a little different as this instrument is not a self-contained indicator or recorder. Its application is more common in plants and refineries where control and measurement houses are centralized and may be some distance from the primary unit. The "cell," when installed at the orifice, is a transmitter putting out a 3-15-psig pneumatic signal over the differential range. Therefore, it must be coupled with a receiver for use as a recorder and, for compressible fluids, requires a pressure recording system also.

The Future

What lies in the future of inferential measurement? It is hard to tell from today's activities, but it is certain to become even more widely used and accepted than ever before. Starting with the measurement of a few thousand cubic feet of natural gas over a half century ago, the field has grown until today nearly all gas produced is measured at least twice in its flow by orifice meters. In addition, nearly every other fluid used in process or refinement, both compressible and noncompressible, is measured somewhere by use of inferential meters. Tomorrow will find liquid and steam coefficients standardized, as are today's gas coefficients, with even more country-wide standardization in basic plant problems (such as a common pressure base rather than eight or more different bases in use today). As far as tentative standards of the S.C.M.A., C.N.G.A., and P.C.G.A. go, the future will most likely produce a treatise on liquid coefficients, one for steam coefficients, and possibly a consolidation of the deviation- or superexpansibility-factor works.

Refineries, chemical, and other industrial plants will possibly lean toward the transmitter type of differential-pressure cell, coupled with a central computer for integrated process control or automation. Field work may also go to more centralized recording, using telemeter transmission. However, these are only forms of convenience. The basic equation to be solved will remain $Q = C\sqrt{h}$, with little change in the original coefficient C.

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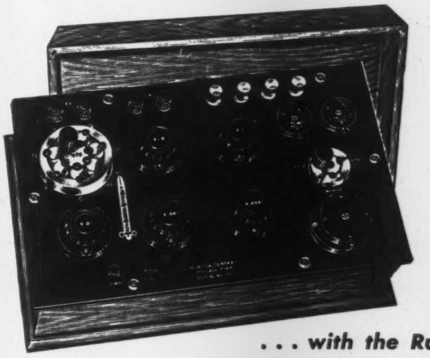

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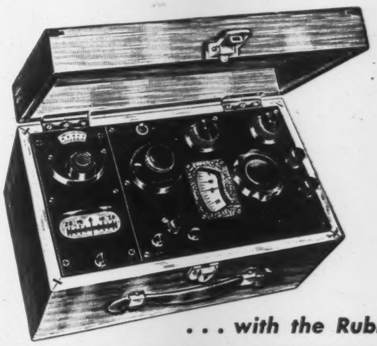

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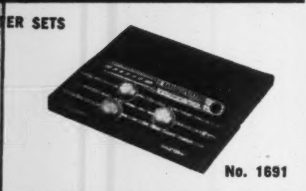
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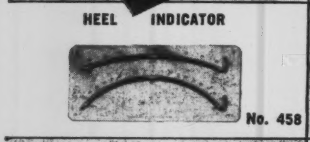
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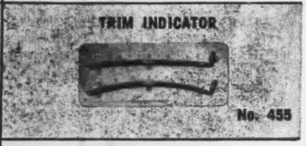
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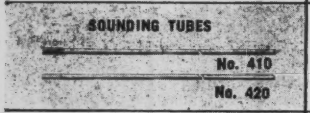
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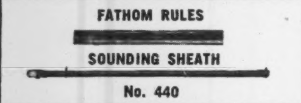
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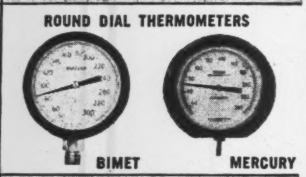
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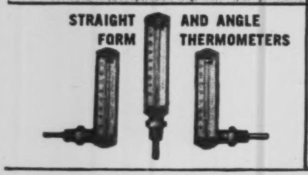
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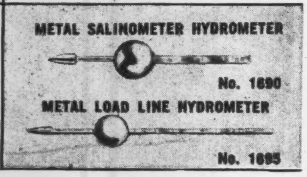
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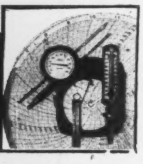

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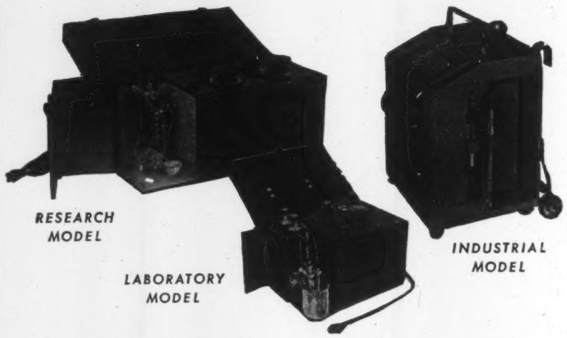
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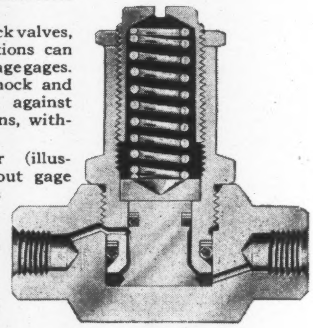

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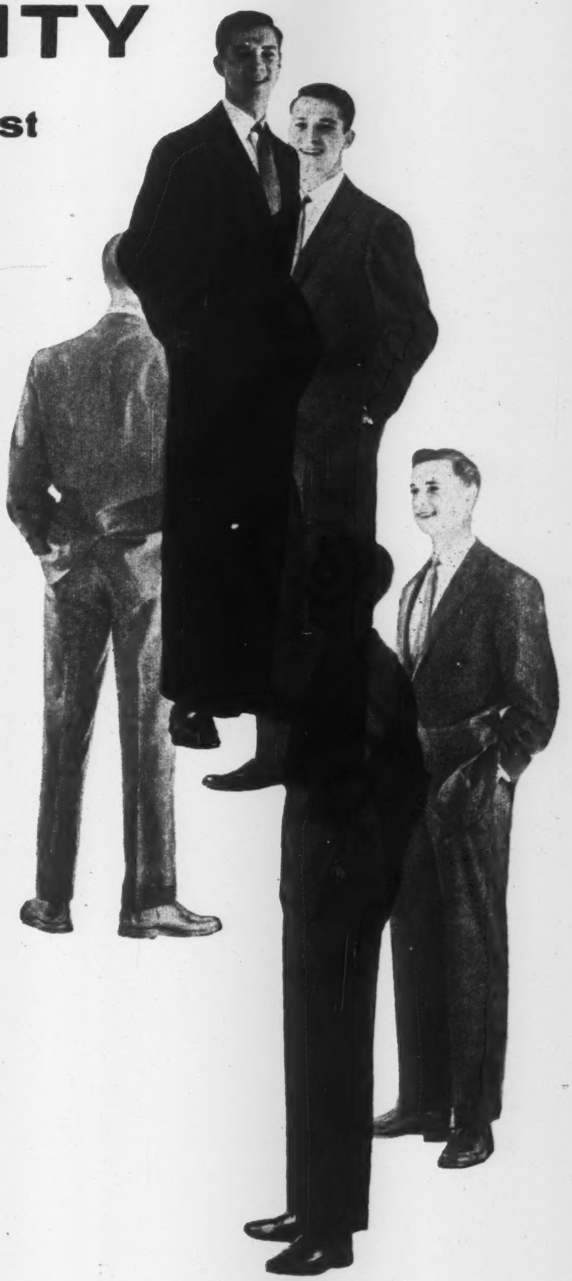

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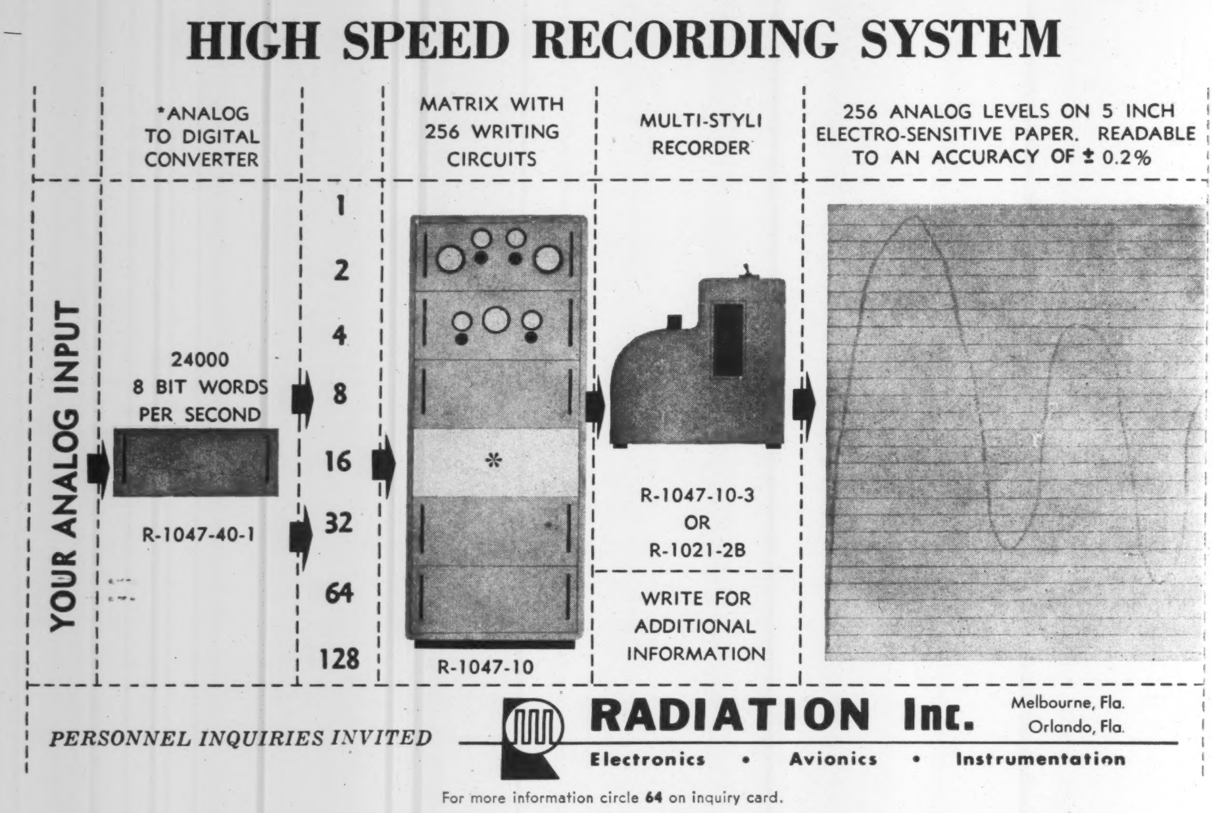

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40° to 100°F	24 Hours
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SIGNIFICANCE

RESEARCH can be well defined as imagination plus instrumentation. The imagination often just happens, but not so the instrumentation. Although the two essential ingredients of a research organization are (1) good scientists and (2) good instruments, the management of research organizations has long been aware that it is not sufficient to hire good scientists and purchase good instruments; too often they don't fit together. Whatever the reason for the mismatch, an essential impedance-matching device has been found in the instrument specialist, the man who knows not only modern instrumentation (including availability and applicability) but also how to assist scientists in adapting the instrumentation to the individual research problem. Such men have now become the third essential ingredient in the research organization.

You will meet the outstanding men in this field in future issues of I&A—Axel Peterson of Mellon Institute of Industrial Research, Clarence Glassbrook of Stanford Research Institute, Edward Roberts of Armour Research Foundation, Allen Latham, Jr., of Arthur D. Little, Inc., etc. This month we wish to acknowledge the important contributions to our field made by Charles F. Lucks, Division Chief, Instrumentation Division, Battelle Memorial Institute, Columbus 1, Ohio. His biography also illustrates the rapid growth of instrumentation within the research organization.

THE story of Bob Angell's life is the story of plant and process instrumentation, particularly flowmetering in the refinery. For 33 years he has been instrument specialist with The Union Oil Company of California, and for most of this time a key figure in the important instrument activities of the Southern California Meter Association. His many contributions to our field include development of some of the earliest differential-pressure flowmeters, petroleum orifice coefficients, and training courses in instrumentation. Many instrument men in the field received their basic training at "Bob Angell's little instrument department on the Hill," and the growth of his department illustrates the growth of plant process instrumentation.

With pleasure, we acknowledge the important contributions to our field made by Bob Angell, and we invite you to meet him and his Instrument Department.

INSTRUMENTS and AUTOMATION

Biographies of significance

ROBERT F. ANGELL

ROBERT F. ANGELL was born in Sioux Falls, South Dakota, July 29, 1897. He spent his early boyhood on the plains of that beautiful state, and received his early education in Sioux Falls. After various jobs in the mining camps, lumber mills and a large oxygen company he arrived at Berkeley and attended the University of California, College of Mining, Class of '21.

His next stop was Long Beach where he first worked as an oil inspector in a laboratory and then a gang pusher, building an absorption plant on Signal Hill. While on that job he observed men taking gas gravities with a Shillings bottle and installing an orifice meter. It was then that he became interested in the measurement of fluid flow in pipelines. When he heard about a job working for the utilities inspector at the Los Angeles Refinery of The Union Oil Company of California at Wilmington, this looked like the opportunity. He went to work there in August 1922, as the Refinery's first full time instrument repairman. The job was not known as such then, as a few recorders, pressure gages and some early displacement meters hardly justified all that attention. However, the management must have been instrument minded, as the assignment was to build up an instrument department, to measure and account for all utilities, and to investigate and make use of such control devices as were available. The job at first consisted of changing the few recorder charts, computing the flows, installing orifice meters—and convincing operators that recording instruments were their useful aids and not checking telltales; also to induce equipment vendors to design and manufacture control equipment to fit the many needs. Many early regulators and controllers were conceived of in this Refinery to fit specific needs, and were manufactured in small shops in Los Angeles, which was the beginning of the instrument industry in California.

In the early 20's (sometimes referred to as the roaring 20's) and soon after oil was discovered on Signal Hill, Bob helped build thirty small mercury-type differential-pressure indicators, at the Refinery, for the purpose of measuring crude-oil flow. The first ones were used to balance crude-oil loads to eighteen pipe stills by measuring the pressure drop through ells in the feed lines.

Bob Angell, and a portion of his instrument department.

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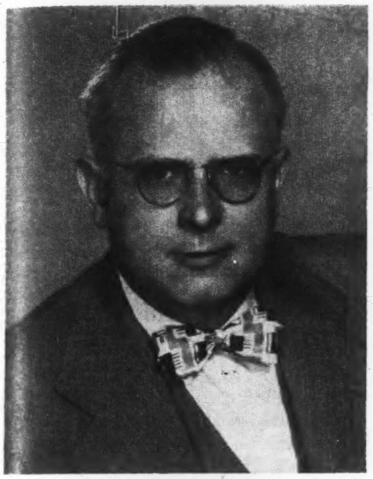
It was soon after this that the self-contained orifice plate, which could be installed between any existing companion flanges, was developed. An easy system of computing petroleum orifice constants was then developed by Bob, consisting of dividing the coefficient into three terms—the line constant, the material constant, and temperature correction factors for petroleum liquids.

Bob was one of the organizers and charter members of the Southern California Meter Association—July 1927, and president in 1929, with a total membership of 242 in that year. He was active in the Association for many years, has served as Chairman of many committees, and has prepared several papers for the Association. He has always been interested in the training phase of instrumentation and, when president of S.C.M.A., was instrumental in having the Association publish perhaps the first correspondence course in gas measurement (which had students enrolled in thirteen different states and two foreign countries in 1930).

Bob has seen instrumentation advance from a side line for any handy man in the refinery to an essential organization of thirty or more specialists (including instrument engineers, electronic technicians, craftsmen and trainees) required to properly service and care for modern refinery instrumentation. He has seen his refinery instrumentation grow from a few pressure gages and early volumetric meters into a department that contains 600 orifice meters, 6000 indicating pressure gages, 3000 thermocouples, some 2500 instruments that operate pneumatically, some 500 instruments that operate electronically, and many elaborate analyzers and other process control instruments.

Bob says, "I have been a reader of *Instruments* since its inception 28 years ago, and a subscriber since 1930. *Instruments,* now *I&A,* has helped keep my department up-to-date, and many ideas were received which aided in training. The monthly issues are circulated among shop members, and they especially give newcomers an enthusiasm for their chosen profession."

Bob is married and lives with his wife in Long Beach near Signal Hill, where he was first introduced to instrumentation. He has a son and two young grandsons living in Southern California. He is a thirty-three-year man with The Union Oil Company of California, and is Instrument Shop Supervisor in the maintenance department of the Los Angeles Refinery at Wilmington.



CHARLES F. LUCKS

CHARLES LUCKS received his B. S. degree in Engineering Physics from Ohio State University in 1928. Following graduation he became associated with the B. F. Goodrich Rubber Company in its physical research laboratory, working on the measurement of the plasticity and coefficient of friction of rubber. In 1930 he joined the staff of Battelle Memorial Institute, where his first assignment was thermal-conductivity measurements associated with the utilization of aluminum foil in thermal insulation. Several years later the calibration of instruments became a "side line" to his thermal-conductivity work.

As the Institute's staff and scope of research problems increased, the instrument work required more of his time. Gradually, as instruments were accumulated for which there was no immediate full-time use, they were placed in a wall-type cabinet and loaned on a serve-yourself basis. The necessity for calibration was determined largely by the user. In 1937 Lucks organized what is essentially the instrument loan system in present use at the Institute, and the calibration of instruments was placed on a semi-annual schedule.

The instrument laboratory occupied its first space as a distinct unit in 1941. In the same year Lucks was made an Assistant Supervisor in Battelle's physics group, and in addition to his thermal-property and instrument work, was given responsibility for the Institute's mechanical-testing, heat-treating, and metal-working laboratories. A glass-blowing laboratory was added in 1943. In 1951 the six named laboratories were organized as the Institute's Instrumentation Division, with Lucks as Division Chief. The division has a staff of 40 and is directly responsible for about three-quarters of a million dollars of equipment. Approximately 30 per cent of this equipment is in the Instrument Laboratory for general loan and for use by the laboratory in its calibration and repair work.

In 1937 the instrument services consisted chiefly of the calibration and loan of about 200 items, and required only part of the time of one staff member. The Instrument Laboratory now has a full-time staff of 18, and its services include the calibration of about 4000 items, the loan of about 2000 items, repairs to a wide variety of equipment, provides information on instruments available from manufacturers and from other divisions within the Institute, consultation on the application and use of instruments on research problems, and research on new instruments.

How does *Instruments and Automation* help in this work? Charles says, "The period of my subscription to I&A covers about eight years. However, the Battelle library has on its shelves for reference all copies of your magazine dating from 1929. The library is now in the midst of collecting the issues of the 1928 volume. Thus, the entire set of I&A will be available for our staff."

Lucks is a member of ISA, APS, AAPT, ASM, and AAAS, and is a registered professional engineer in Ohio. He is active in technical society activities, having served as chairman of the Columbus Chapter of ASM, President of the Columbus Technical Council and the Central Ohio Technical Foundation, and as a member on committees preparing the Tool Engineers Handbook of ASTE and the Welding Handbook of AWS. Currently he is a consulting member of the ASTM subcommittee on heat transfer, trustee of the Central Ohio Technical Foundation, and is a member of ISA Committee D-2 on Research and Development.

His former hobby of photography has been replaced largely by amateur stage productions. He is a past president of both Stagecrafters and National Burnt Corkers. Six of his 20 years of Church School work were spent as General Superintendent of St. John's E and R Church School in Columbus.

Lucks coauthored "The Instrument Laboratory in Research—Its Operation and Services" (ISA Proceedings, Volume 7, 1952), and two papers in the AIP book, "Temperature—Its Measurement and Control in Science and Industry". He is listed in *American Men of Science* and *Who's Who in Engineering.*

Miniature Pressure Transducers

STATHAM UNBONDED STRAIN GAGE TRANSDUCTION

MINIMUM RESPONSE TO VIBRATION OR ACCELERATION

TEMPERATURE COMPENSATION OVER 315° F. INTERVAL

20 MILLIVOLTS AT 5 VOLT EXCITATION

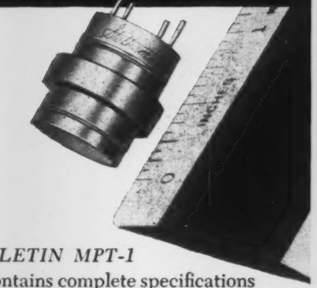
PRESSURE ADAPTERS FOR CLOSED LINE APPLICATIONS

HOMOGENEOUS SENSING DIAPHRAGM SURFACE

NO EPOXY RESIN PRESSURE SEALS

MAXIMUM LINEARITY

ABSOLUTE PRESSURE
0-5 to 0-150 PSIA . . . MODEL P130
DIFFERENTIAL PRESSURE
± 2.5 to ± 25 and 0-5 to 0-150 PSID . . . MODEL P131
GAGE PRESSURE
0-5 to 0-150 PSIG . . . MODEL P132



BULLETIN MPT-1
contains complete specifications
on the foregoing
pressure transducer models.

All matters pertaining to sale or use of
instruments of our manufacture
are handled by engineering personnel
directly from our Los Angeles plant.

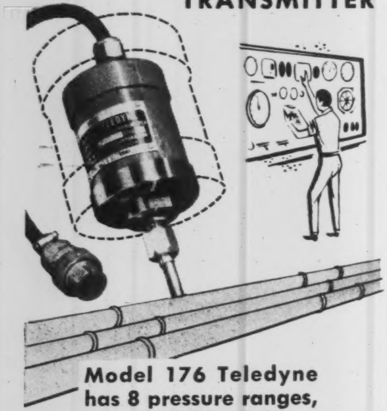
*Please feel free to wire or
telephone us collect whenever we
may be of service.*

Statham
LABORATORIES
[illegible] Los Angeles [illegible]

For more information circle **69** on inquiry card.

REDUCED in size for use in restricted areas

Teledyne
BONDED STRAIN GAGE
ELECTRICAL PRESSURE TRANSMITTER



Model 176 Teledyne has 8 pressure ranges, up to 10,000 P.S.I.

Especially designed for use in applications where space is at a premium, the new Model 176 has all the major features of the larger Model 158 Teledyne with the added ability to withstand overload up to 100%. Only 2¼" in diameter and 3½" long, it is one of the most advanced pieces of equipment of its kind available. It measures, and transmits pressures of gases and fluids to indicating and recording instruments and has a host of exclusive features found nowhere else. Bonded strain gage construction (insensitive to vibration and shock), stainless steel pressure chamber, high frequency response, linear output over full pressure range, temperature compensated for zero shift and sensitivity change. Easily disassembled for clean-out and repairs.

PLEASE NOTE: Contact us for calibration service on Pressure Transducers. 0 to 25,000 P.S.I.

Write for Illustrated Literature

TABER INSTRUMENT CORPORATION
SECTION 75
111 Goundry St., N. Tonawanda, N. Y.

For more information circle **70** on inquiry card.

INSTRUMENTS and AUTOMATION Events

For other computer Events see page 104.

January 25-27

Eleventh Annual Conference on Instrumentation for the Process Industries, sponsored by Chemical Engineering Dept., Texas A&M, will be held on campus. For information write Chemical Engineering Dept., Texas A&M, College Station, Texas.

January 26

Eighth annual college-industry conference sponsored by the American Society of Engineering Education at Marquette University, Milwaukee, Wis.

January 26-27

Fifth Annual Instrument Short Course at Los Angeles Harbor Junior College, Wilmington, Calif. For information write E. W. Kramer, Chairman, 5th Annual Short Course, Southern California Meter Assoc., 640 Fillmore St., Fillmore, Calif.

January 30-February 1

Seventh Annual Southeastern Symposium on Industrial Instrumentation will be held on the campus of the University of Florida. For information write W. C. Hackler, College of Engineering, Gainsville, Fla.

February 2-3

IRE National Symposium on Microwave Theory and Techniques, University of Penna., Phila., Pa.

February 8-10

Western Joint Computer Conference, sponsored by the AIEE, IRE and Association for Computing Machinery, Fairmont Hotel, San Francisco, Calif. For information write: AIEE Hdqtrs., 33 W. 39th St., New York, N. Y.; or B. J. Bennett, Stanford Research Institute, Stanford, Calif.

February 9-11

8th Annual Southwestern IRE Conference & Electronics Show, Municipal Auditorium, Oklahoma City, Okla. For information write M. W. Thomas, P. O. Box 764, Oklahoma City, Okla.

February 15-17

Third Conference on High-Speed Computers will be held on campus, Louisiana State University, Baton Rouge, La. For information write J. W. Brouillette, General Extension Div., Louisiana State U., Baton Rouge 3, Louisiana.

February 16-17

IRE-AIEE Conference on Transistor Circuits will be held at the Irvine Auditorium and the University Museum Auditorium, 34th & Spruce Sts., University of Pennsylvania, Philadelphia, Penna. For information write Joseph D. Chapline, Research Division, Philco Corp., Tioga & "C" Sts., Philadelphia 34, Penna.

February 22-March 2

British Industrial Fair, Earls Court, London, England. For information contact British information Service, 30 Rockefeller Plaza, N. Y. 20. N. Y.

February 27-29

Symposium on Microwave Crystal Rectifiers & Their Applications, sponsored by Asst. Secy. of Defense, Advisory Group on Electron Tubes, Hexacon Bldg., Signal Corps Engineering Labs, Ft. Monmouth, N. J. For information contact W. G. Matthei, Evans Signal Lab., Belmar, N. J.

February 28-29

Scintillation Counter Symposium, sponsored by the IRE and AIEE, Shoreham Hotel, Washington, D. C.

March 5-7

Sixth Conference on Instrumentation in the Iron & Steel Industry, Hotel Webster Hall, Civic Center, Pittsburgh, Pa. For information contact Richard Rimbach Associates, 845 Ridge Ave., Pgh 12, Pa.

March 18-24

Consecutive Meetings and Co-Exhibit of American Congress on Surveying and Mapping and the American Society of Photogrammetry, Shoreham Hotel, Washington, D. C. For information write ACSM-ASP, Box 470, Washington 4, D. C.

March 19-22

IRE National Convention & Radio Engineering Show, Waldorf-Astoria Hotel and Kingsbridge Armory and Palace, New York, N. Y. For information contact Wm. A. Copp, IRE, 1475 Broadway, New York 36, N. Y.

March 19-29

Ninth annual short course in Quality Control by Statistical Methods, College of Engineering, University of Illinois. For further information write to Professor John A. Henry, Mechanical Engineering Laboratory, University of Illinois, Urbana, Illinois.

March 26-27

ASM Instruments & Regulators Conference, Princeton University, Princeton, N. J.

April 5-6

Special Technical Conference on Magnetic Amplifiers, cosponsored by AIEE Committee on Magnetic Amplifiers, IRE Professional Group on Industrial Electronics and ISA Central New York Sec., Hotel Syracuse, Syracuse, N. Y. For information write Charles F. Spitzer, General Electric Co., Bldg. 3, Electronics Park, Syracuse, N. Y.

April 13-14

Tenth Annual Spring Television Conference sponsored by the Cincinnati Section of the Institute of Radio Engineers will be held at the Engineering Society of Cincinnati Building, 1349 E. McMillan St., Cincinnati, Ohio. For information write Reuben Nathan, Crosley Div., Avco .Mfg. Corp., Glendale-Milford Rd., Evendale, Ohio.

April 25

Symposium on "Control Systems Engineering—Electronic Controls In Industry" sponsored by the Wilmington Section, ISA. For information contact W. G. Schmick, Minneapolis-Honeywell Regulator Co., Orange St., Wilmington, Del.

April 26-27

Technical Conference on Electrical Recording and Controlling Instruments sponsored by AIEE, ASME and ISA cooperating, to be held at the Hotel Bradford, Boston, Mass. For information contact E. T. Davis, Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

May 14-17

The Physical Society 40th Exhibition of Scientific Instruments and Apparatus, Royal Horticultural Society's Halls at Westminster. For information write Exhibition Secretary, 1, Lowther Gardens, Prince Consort Rd., London, S.W. 7, England.

May 14-19

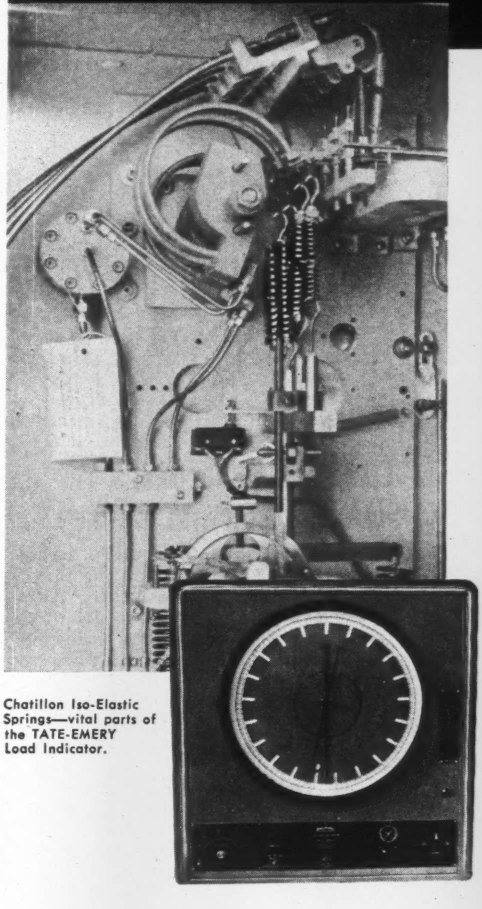
International Colloquim on Spectroscopy, 6th annual meeting to be held at Amsterdam, Netherlands. Persons wishing to attend or contribute should correspond with the Secretary, Colloquim Spectroscopicum Internationale, Laboratorium voor Analytische Chemie, 125 Nieuwe Achtergracht, Amsterdam-C4, Netherlands.

November 26-30

Third International Automation Exposition, New York Trade Show Building, 500 8th Ave., New York, N. Y. For information write Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 12, Penna.

CHATILLON
ISO-ELASTIC* Precision Springs

insure force measurement accuracy despite wide temperature variations . . .



Chatillon Iso-Elastic Springs—vital parts of the TATE-EMERY Load Indicator.

Tate-Emery Weighing Heads, used in conjunction with Baldwin-Lima-Hamilton Test Equipment, incorporated the famous CHATILLON developed ISO-ELASTIC precision spring to obtain greater accuracy under wide variations of temperature and loading conditions.

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Learn how CHATILLON, maker of "the World's Most Accurate-precision Spring", can help you with your force measurement, temperature problems.

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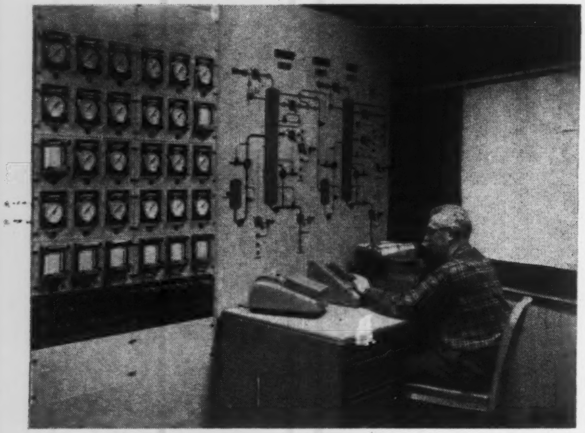
Manufacturer of Precision Springs and Measuring Apparatus Since 1835

For more information circle **72** on inquiry card.

INSTRUMENTS and AUTOMATION

New Instruments

PROCESS MEASUREMENT AND CONTROL



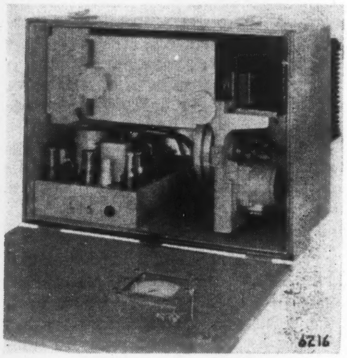
INTERLOCKED PROCESS SCANNING AND CONTROL CENTER

New "Trans-Scan-Log System" is unique in that it coordinates all related process data, enabling operator to visualize, evaluate, and act upon every processing irregularity the moment it occurs. It summarizes all processing data on a graphic panel and adjacent panel of miniature indicating and recording receivers. Graphic panel section (right) does not have to provide space for insertion of receivers on diagrams of processing units or process lines. Therefore this section can compress a normal 20-ft graphic panel into 5 ft. Instrument panel requires only enough space to accommodate fronts of receivers. Numbered lights correlate graphic panel and instruments. Continuous point scanning rate is one point per second and a signal light glows (white, red or amber) to indicate point and condition. Scheduled point logging can be set for every hour, half-hour or as often as desired. Any off-normal condition not only produces audible and visual alarms, but causes time, point value and station number to appear in lighted blocks at top of graphic panel and to be printed by auxiliary column printer. Red or amber off-normal signal lights appear both on graphic panel and process-control panel. When off-normal condition occurs during scheduled logging, time, point value and station number type out on automatic typewriter as well as on column printer. Audible off-normal alarm can be acknowledged by operator, but off-normal signal lights and visual alarm remain on until process condition is remedied. Auxiliary printer can be set to print return to normal conditions following process upset or it can continue to print off-normal values each time off-normal point is scanned. In addition, operator can readout any process point on demand by pressing station selector buttons. Complete logging of all points can be called for by operator at any time. Data are received from process by pneumatic or electric transmission, covering temperatures, pressures, flow-rates, levels, densities, etc. An adjacent panel (not shown) electronically converts process data to electrical impulses to digitizing and logging equipment. Providing accounting or marketing departments with production data can be accomplished on punch cards or tape by auxiliary equipment. Among unique design features: (1) if a process irregularity should show up on an indicator, indicator can be unplugged and a recorder plugged-in in seconds. (2) Order in which processing points are scanned can be altered at will by re-plugging relay racks. (3) A change in basic process can be economically reproduced on graphic panel section because there are no instrument cut-outs.—*Taylor Instrument Companies, Rochester* 1, *N. Y.*

For more information circle **201** on inquiry card.

PROCESS CONTROLLER

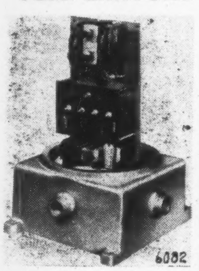
New "Model III Photoelectric Analyzer" features self-monitoring: it not only records or controls a chemical process, but periodically checks



and re-sets itself to compensate for smudge accumulation on cell windows or similar sources of error. Aside from liquid analysis in process work, in stream pollution studies, etc., it will record minute quantities of gas or vapor in air; can be set to warn of presence of noxious vapors, or as a leak detector.—*Manufacturers' Engineering Equipment Corp., Hatboro, Pa.*

For more information circle **202** on inquiry card

TEMPERATURE TRANSMITTER



New "ST-8900 Remote Temperature Reading System" can be installed by itself or in conjunction with maker's "Telepulse System" for liquid level gaging. It gives reading from any point where communication facilities can or do reach, such as private or leased wires, carrier or microwave. Normal span 130 F° with readings to nearest 1 F°. Top limit of range 500°F.—*Shand & Jurs Co., Berkeley* 10, *Calif.*

For more information circle **203** on inquiry card.

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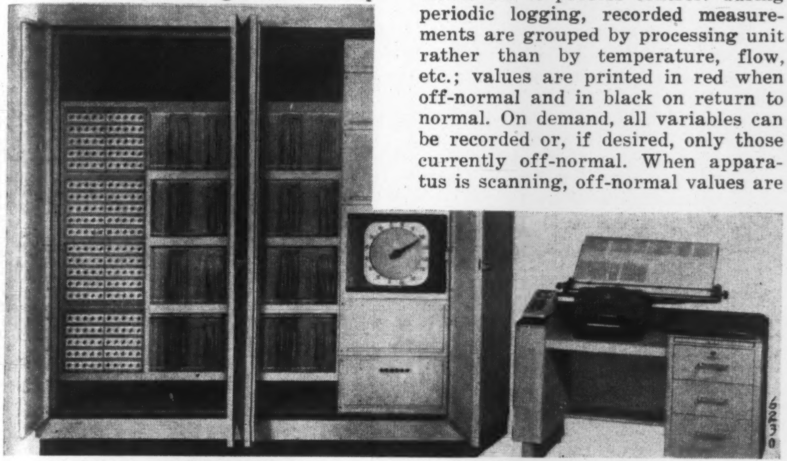
FOR FURTHER INFORMATION use the postage-free order card on page 193.

DUAL-FUNCTION PROCESS-INFORMATION SYSTEM

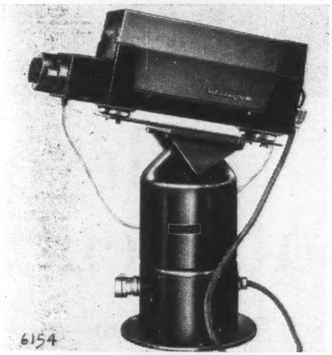
New "Panelog 605" performs dual functions of high-speed scanning and automatic logging of process variables. Basic system logs and scans up to 200 input variables and uses one digital printer; expanded systems handle any number of points and use two or more printers. All of system's output, or any desired part, can be recorded on punched tape. Data can be fed directly to computers for accounting or engineering analysis. "Panalog 605" uses two separate measuring systems: (1) precision servo measuring system quantizes process variables during periodic logging; (2) high-speed electronic measuring system detects off-normals during continuous scanning of all variables. When detected, off-normal signals are switched to servo system for measurement and readout. Information is presented in meaningful form as a direct aid to process control: during periodic logging, recorded measurements are grouped by processing unit rather than by temperature, flow, etc.; values are printed in red when off-normal and in black on return to normal. On demand, all variables can be recorded or, if desired, only those currently off-normal. When apparatus is scanning, off-normal values are identified and printed in a separate area of log chart; an audible alarm sounds and a visual alarm flashes. Data can be recorded in different patterns in successive chart segnments so that a single chart can accommodate many measurements. If desired, apparatus can operate two digital recorders for off-normal printout and to record periodic log. Each point measured has its own high and low off-normal settings and system includes off-normal memory circuits. —*Panellit Inc.*, 7401 *Hamlin Ave., Skokie, Ill.*



For more information circle **204** on inquiry card.

REMOTE-CONTROL ITV

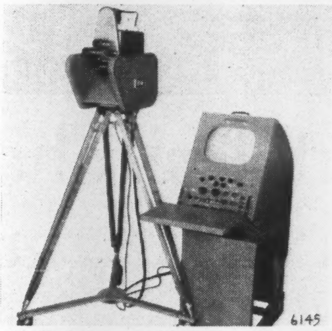
New remote control pan and tilt mount, for use with maker's "Utili-Vue" or any other industrial television camera, can be successfully used on outdoor and indoor installations. Rotation is 360° or limited to any arc desired; tilt is 45° above horizontal and 45° below. Complete 360° rotation is accomplished in 36 sec; pan and tilt motions are driven by separate motors. Remote control panel (not shown) can be located at any desired point.—*Electronics Dep't, Diamond Power Specialty Corp., Lancaster, Ohio.*



For more information circle **205** on inquiry card.

REMOTE-CONTROL ITV

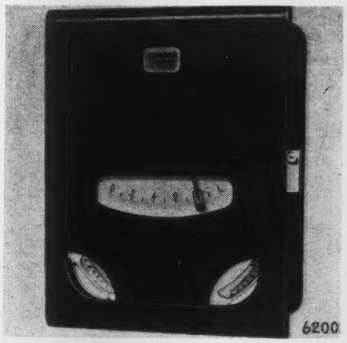
New "285-A Servo System" is said to make possible "for the first time closed-circuit TV installations remote controlled to provide operator safety in hazardous locations, assure undetected operation in security and surveillance work, and permit quick and accurate viewing of widely spaced objectives." Lenses on camera are changed, focusing is set, and camera is directed up or down, right or left, by remote control. In addition, three "pre-set" directions selectable by pushing a button.—*Dage Television Div., Thompson Products, Inc., Michigan City, Ind.*



For more information circle **206** on inquiry card.

LOW PRESSURE CONTROLLER

New "Model R-1051 Static Pressure Indicator-Controller" features free-floating slack diaphragm said to permit extreme accuracy at ranges as low as 0-0.2" water. Instrument can be used for pressures above or below atmospheric, or for maintaining a constant differential between two pressures. Available ranges up to 6" water.—*Johnson Service Co., Milwaukee 1, Wisconsin.*



For more information circle **207** on inquiry card.

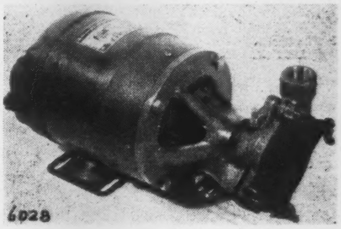
MASS FLOWMETER

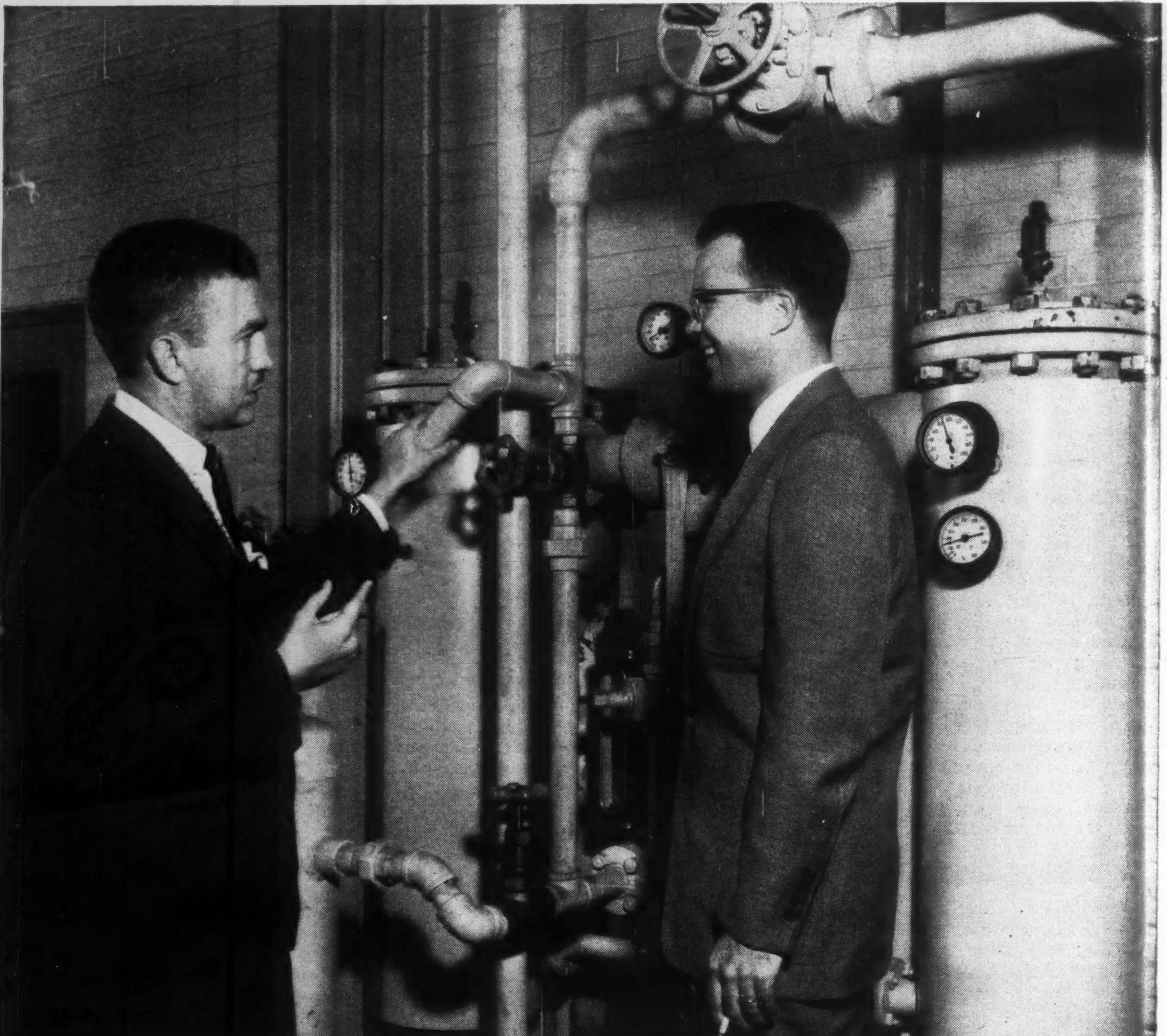
New Extended Range Mass Flowmeter is self-adjusting for specific variations from 0.600 to 0.900; has gravity range of 30,000-to-1 or more. Accuracy is well within 0.5% of full-scale for each of the five scales used to cover entire range. Switching from one flow sensing element to another is accomplished automatically whenever flow passes above or below range of sensing element in operation. Fluid density is constantly measured by means of a unit which produces a proportional change in a variable resistance. Instrument itself is a standard precision indicating electronic potentiometer. Flowmeter is applicable to measurement of any clean fluid having a reasonably low viscosity. Although extended range unit is intended primarily for test work and as a flow-rate standard, single-range units are available.—*Potter Aeronautical Co., Route #22, Union, N. J.*

For more information circle **208** on inquiry card.

CENTRIFUGAL PUMP

New "Centri-Chem" Type 20 Alloy centrifugal pump features greater volumetric capacity and materially re-





"Is this that Pritchard Hydryer you've been raving about, Ben?"

"Yes, and isn't it a honey?"

"You're pretty happy about it aren't you?"

"You bet I am. Remember those few months before we got our Hydryer? Those nights and weekends we had to work trying to keep all those precision instruments operating. If it wasn't moisture that was fouling things up, it was corrosion."

"I remember only too well. Say, Ben, how did you get a line on that Pritchard Hydryer in the first place?"

"I sent for a copy of their bulletin on the Hydryer. Afte I read it I talked it over with the chief and we ordere ours. You know this unit does everything their literatur said it would. Right now we're pulling 63 pounds o water from our instrument air every day. It dries 16 SCFM at 100-psig., and 90°F."

"All I know is that things are a lot different around her since we put that Hydryer in. C'mon, let's go home. Tha air is in good hands."

J. F. PRITCHARD & CO. OF CALIFORNI
4625 Roanoke Parkway, Kansas City 12, Mo.

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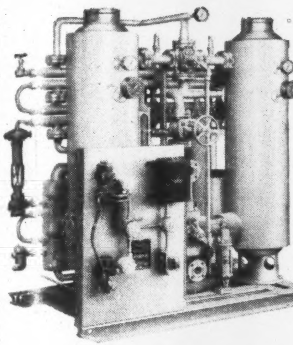

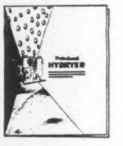

"Is this that Pritchard Hydryer you've been raving about, Ben?"

PRECISION INSTRUMENTS DEMAND DRY AIR The PRITCHARD HYDRYER* DELIVERS IT!

The Pritchard HYDRYER is a low-cost, packaged dehydration unit. It is ideally suited for use with precision instruments. The HYDRYER effectively removes moisture from air, carbon dioxide, synthesis gas and many other gases.

These exclusive design features make the HYDRYER superior to any other such unit on the market today:

- 100% of all air or gas entering is dried without loss.
- Full line pressure reactivation.
- Purging eliminated; HYDRYER uses inlet main air stream for reactivation.
- Longer adsorbent life; no movement due to pressure changes, high velocity.
- No moving parts . . . simplified design . . . . . plus many, many more!

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For more information circle 73 on inquiry card.

duced net positive suction head, by increasing suction port size from ¾" to 1" pipe thread while retaining ¾" discharge port. Available with closed or semi-open impellers; can be opened for cleaning without removal from line; can be rotated 360° within mounting bracket to permit easy incorporation into existing systems or OEM equipment.—*Eco Engineering Co.*, 12 *New York Ave., Newark* 1, *N. J.*

For more information circle **209** on inquiry card.

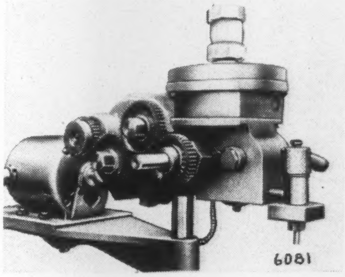
CHEMICAL PUMP

New "Chlor-O-Feeder" is an all-purpose diaphragm pump for feeding chemicals in industry and municipalities. Among features: unit can be powered by electric motor, rotating shaft or gasoline engine; low first cost; easy installation; "See-thru" pumping head; interchangeable measuring chambers for variety of chemicals.—*Proportioneers, Inc.*, 345 *Harris Ave., Providence, R. I.*

For more information circle **210** on inquiry card.

METERING-PUMP DRIVE

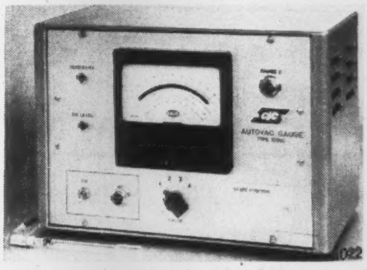
New gear train drive developed for maker's metering pumps enables accurate delivery of more than 300 cc of viscous materials in a single discharge, permits several hundred quantity adjustments for any one pump, using standard interchangeable gears. Solenoid can be actuated by a foot control, by low-travel switch or other mechanical or electrical impulse, for synchronizing with conveyors or indexing tables—*Edward E. Robinson, Inc.*, 95 *Park Avenue, Nutley* 10, *N. J.*



For more information circle **211** on inquiry card.

VACUUM GAGE

New "Autovac" four-station vacuum gage (made in Sweden) gives continuous pressure readings from 100 mm down to 1 micron Hg, is of self-balancing direct-reading hot-wire type, is said to provide "a higher degree of calibration stability than any other instrument of its type." Features: (1) automatic switching from millimeter range to micron range, (2) ability to actuate relay circuit for operation of valves, etc.—*Consolidated Vacuum Corp.*, 1775 *Mt. Reed Blvd., Rochester* 3, *N. Y.*



For more information circle **212** on inquiry card.

HIGH-TEMPERATURE TC

New thermocouple with platinum 30% rhodium *versus* platinum 6% rhodium calibration can measure temperatures up to 1800°C (3272°F). It extends industrial temperature measurement range beyond limits of conventional noble-metal couple, but neither sensitivity nor corrosion resistance is sacrificed.—*Thermo Electric Co., Inc., Saddle River Township, Rochelle Park P. O., N. J.*

For more information circle **213** on inquiry card.

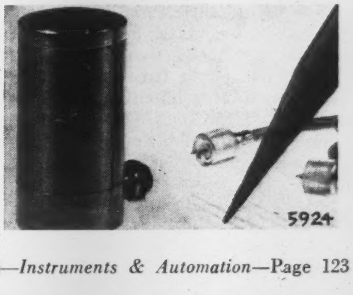
DIFFERENTIAL-PRESSURE SWITCHES

New "Series 6300" differential pressure switches for aircraft and missile system applications withstand vibration up to 35 *G* and temperatures from −65°F to 165°F; are sealed with O-rings for protection against moisture; are available with Cannon plug or with lead wire connections. —*Southwestern Industries, Inc.*, 5880 *Centinela Ave., Los Angeles* 45, *Calif.*

For more information circle **214** on inquiry card.

VIBRATION PICKUP

New "M-191" light-weight (1-oz) linear acceleration pickup employs ADP crystal; is designed for use over

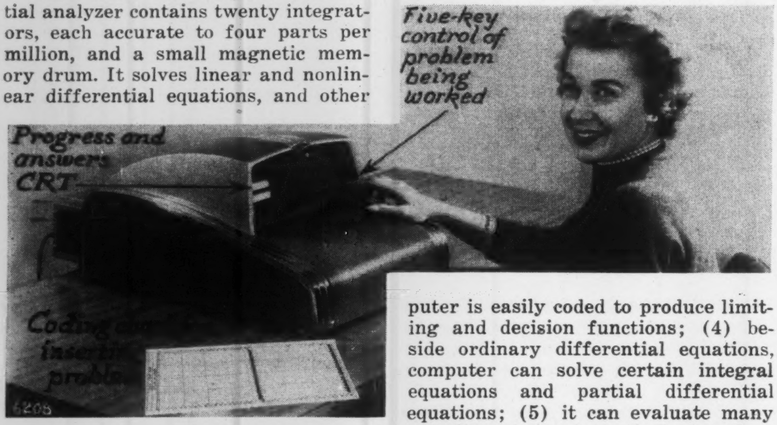


frequency range 10 to 30,000 cps; dynamic range 0.001 to 1000 G; mounts through a tapped hole in its base; comes with 18" length of low-noise coaxial flexible cable with Microdot connectors. Structure is stiffness-controlled throughout its entire frequency range of operation and therefore "ideally suited for making transient vibration measurements." Sensitivity per G is independent of frequency over entire operating frequency range.—*Massa Laboratories, Inc., 5 Fottler Rd., Hingham, Mass.*

For more information circle **215** on inquiry card.

COMPUTING, DATA PROCESSING etc.

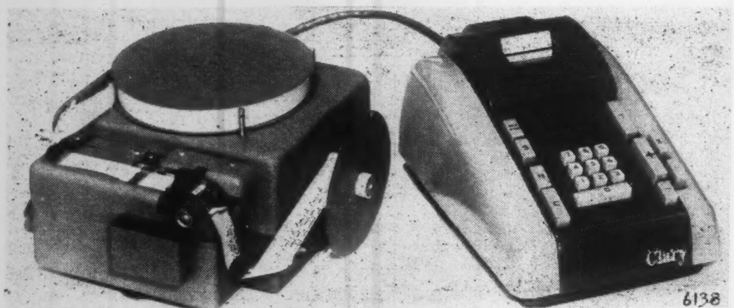
PORTABLE ELECTRONIC DIGITAL COMPUTER



New "Litton 20" digital differential analyzer contains twenty integrators, each accurate to four parts per million, and a small magnetic memory drum. It solves linear and nonlinear differential equations, and other mathematical problems which can be put in differential form, by an iterative process completed 60 times per second (individual operations thousands of times per second). Among features. (1) equations can have variable dx and/or dy inputs to each integrator; (2) arbitrary functions can be generated within computer or obtained from curve followers; (3) computer is easily coded to produce limiting and decision functions; (4) beside ordinary differential equations, computer can solve certain integral equations and partial differential equations; (5) it can evaluate many complicated mathematical functions when they are expressed in differential notation; (6) no drift, each solution precisely repeatable, therefore it is possible to obtain exactly those small differences in results that are due to change in parameters.—*Litton Industries, 336 N. Foothills Rd., Beverly Hills, Calif.*

For more information circle **216** on inquiry card.

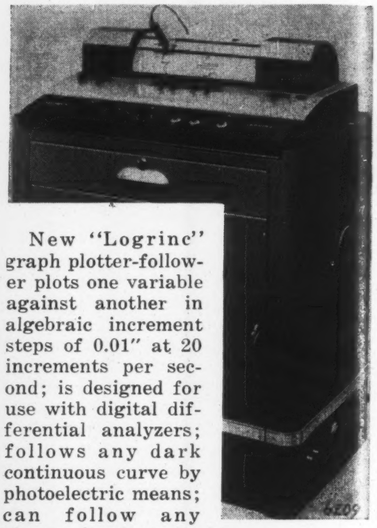
TAPE PUNCH



New "Automatic Punch Tape Unit" for integrated data processing produces a high-speed, five-to-eight-channel punched paper tape from a modified Clary adding machine; perforates tape at rate of 20 code characters per second. Electrical output adding machine, with commutating mechanism, is available in ten-key model and in two full-keyboards, with eight- and 11-column totaling capacities (easy conversion to other machines with smaller or larger totaling capacities). Tape punch can be operated by remote control with cable connection to adding machine; can be used in a hookup of multiple machines. An error key which creates a coded signal on tape can be added to machine keyboard.—*Electronics Div., Clary Corp., San Gabriel, Calif.*

For more information circle **217** on inquiry card.

COMPUTING PLOTTER



New "Logrinc" graph plotter-follower plots one variable against another in algebraic increment steps of 0.01" at 20 increments per second; is designed for use with digital differential analyzers; follows any dark continuous curve by photoelectric means; can follow any change in slope for single values of x and can follow a line of any slope up to and including infinity.—*Logistics Research Inc., 141 S. Pacific Ave., Redondo Beach, Calif.*

For more information cicle **218** on inquiry card.

DATA PROGRAMMER

New "Model PC-105 Programmer" is a modular unit for use with all types of digital data recording equipment. It operates a typewriter, paper tape punch, or 10-key electrical-input adding machine, by taking data in parallel form and presenting these data in serial form to operate output devices. Enough control functions are also available to control recording devices completely so that desired format can be obtained. Provisions for space, tab and special coding are incorporated; also any 4, 5, 6, or 7-hole code in binary, Grey, or binary decimal can be obtained from its output. It can prepare and present word structure in required format for computer inputs. In stock for quick delivery: internal plugboard allows stock units to be set up rapidly to meet user's programming requirments. Standard relay rack mounting with hinged front panel for easy accessibility.—*Datex Div., G. M. Giannini & Co., 918 E. Green St., Pasadena 1, Calif.*

For more information circle **219** on inquiry card.

SLAVE TYPEWRITER

New solenoid-operated slave typewriter makes possible split-second typewritten recording of instrument readings and other scientific and business data by means of electric impulses. Rate: 11 characters per second. Available in carriage widths for lines up to 25"; can also be used manually as electric typewriter; has 43 typebars with 86 characters as standard equipment; optional features include

6295

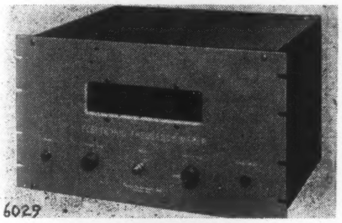
automatic solenoid controls to switch from black to red ribbon. Non-standard keyboards for medical, chemical, mathematical, engineering and other purposes can be obtained. Non standard line space ratchets also are available as well as 8 or 9 pitch horizontal spacing and 44 or 46 typebar models. —*Underwood Corp.*, 1 *Park Ave.*, *New York* 16, *N. Y.*

For more information circle **220** on inquiry card.

TIME, SPEED and COUNT

FREQUENCY COUNTER

New events-per-unit-time meter features digital in-line readout. Readings stay constant during sampling



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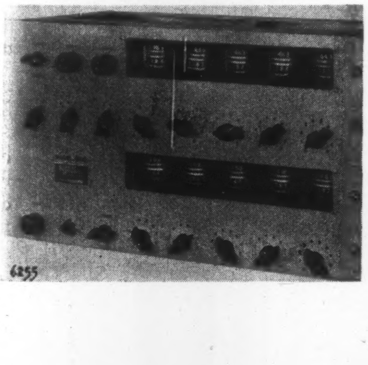
period; no lost readings. Decimal coded contacts give simple direct print-out without "dead-time." Instrument will operate all types of printers.—*Electro Instruments, Inc.*, 3794 *Rosecrans, San Diego, Calif.*

For more information circle **221** on inquiry card.

TIMER AND COUNTER

New "Model 1500 Digitac" combines functions of several instruments: measures time, frequency or events; can be used as a counting or measuring device in process control, as part of a computer, as a test instrument for communications equipment, etc. Its ten plug-in decade counters are



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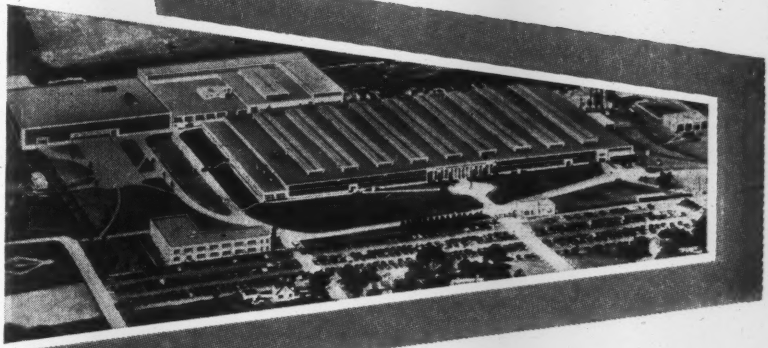
SERVOMOTORS?



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For more information circle **74** on inquiry card.

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for remote indication and control of

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ANGULAR DISPLACEMENT

Cost-saving Elinco Commercial Type Units are right by every indication — just what you need for day-in-day-out use, or for special indicator-control applications — yet you save up to half the usual cost with Elinco —

★*Motors and Generators* for direct "back-to-back" indicator installations

★*Resolvers* for use in torque amplification and servo control systems where extreme accuracy is not required

★*Phase Shifters* where "sensing" must be expressed as a phase relationship

★*Rotatable Transformers* where rotor displacement varies voltage output, for process control and similar applications

FEATURES AND SPECIFICATIONS — Every Elinco unit is a precision instrument manufactured to highest standards, 100% electrically tested, individually balanced dynamically and statically, and carefully produced under step-by-step quality control of all components.

Type	Dimensions	Accuracy	Torque at Max. Phase Displacement	Torque Gradient within ±10° Displacement
Midget	2½" dia. x 3"	3°	2.5 oz. in.	.03 oz. in./deg.
FB	2½" dia. x 4"	2°	4.2 oz. in.	.053 oz. in./deg.
A	3⅜" dia. x 6⅜"	1°	18.0 oz. in.	.28 oz. in./deg.

All above types have 115-volt, 60-cycle primaries, 34-volt secondaries. Special units can be supplied with accuracies, torques, and electrical characteristics to order.

When you specify Elinco Self-synchronous Units, you not only save substantially, but you receive units made by specialists with years of experience producing instrument-type rotary electrical equipment, outstanding for efficient design, precision, and quality. Send us your specifications . . . let us go to work for you now.

COMMUTATOR MOTORS ★ AC MOTORS ★ AC and DC GENERATORS ★ SPECIAL ROTARY UNITS

Custom manufactured in a variety of types to meet individual specifications for precision instrument and control applications. Write for catalogs.

ELECTRIC INDICATOR COMPANY, INC.
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For more information circle **75** on inquiry card.

arranged in two banks of five each. Switches permit connection as a five, ten or dual-fivedecade counter or timer; as a pre-set timer or counter; as a combination timer and counter, or as an electronic delay circuit. It will count up to 10 billion at a rate up to 100,000 per second. Timing capacity 10 usec to 100,000 sec (27.8 hr); timing increments can be preset at any value in 10-usec steps within that range. Count can be preset at any value to 10 billion with both banks in series, or up to 100,000 in each bank used separately.—*Ransom Research, P. O. Box* 382 *San Pedro, Calif.*

For more information circle **222** on inquiry card.

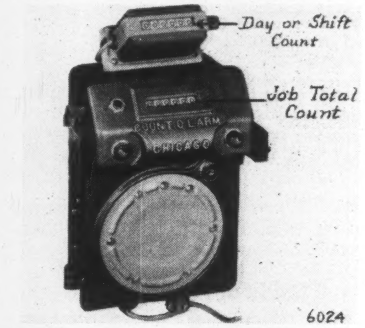
ELECTROPLATING TIMERS

New improved models of maker's timer for precision timing of short-cycle precious-metal electroplating eliminate guesswork and human error. Device starts timing automatically when work contact is made, and automatically rests itself when work contact is broken. Available from stock: 0-1-minute models with amperage load 8-45 or 18-100; 0-3-min models 8-40 or 18-100 amp; and 0-5 min 8-40 or 18-100 amp.—*Technic Inc., Providence, R. I.*

For more information circle **223** on inquiry card.

TWIN COUNTER

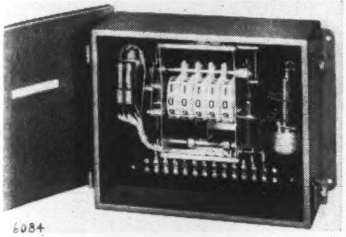
New modification of standard "Count-O-Larm" for automatic screw machines comprises two separate counters: one (sealed) registers total job production and can only be reset to zero when housing is unlocked by authorized personnel; second counter can be used to register shift production, etc., has an external reset knob. Features: (1) instrument registers only full-length parts; (2) buzzer sounds and lamp flashes when bar stock has run out.—*Count-O-Larm Co.,* 1271 *W. North Ave., Chicago* 22, *Ill.*



For more information circle **224** on inquiry card.

PRESET COUNTER

New "Batch Counter" controls number of items in a batch to be counted or measured, with control of quantity before or after an operation, as desired. At each impulse a subtraction of "one" is made from the preset fig-



6084

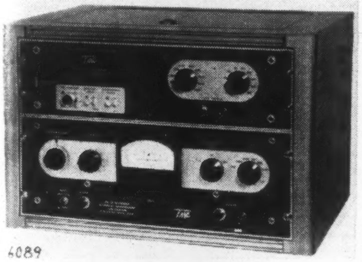
ure until counter reaches zero. Counter then stops machine, rings bell, etc. As further impulses are received, counter adds "one" for each impulse until it reaches original preset figure, then it again performs control function and then starts subtracting operation over again, and so on until preset figure is changed.—*Spencer Mfg. Co.,* 3253 *N. Cicero Ave., Chicago* 41, *Ill.*

For more information circle **225** on inquiry card.

NUCLEONICS

AMPLIFIER-RATEMETER

New "Model RM-1B-103" comprises maker's "Model RM-1B Ratemeter"



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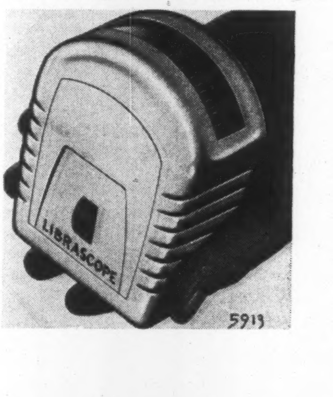
plus an amplifier high-voltage unit, for direct use with the usual nuclear detectors.—*Technical Measurement Corp.,* 140-142 *State St., New Haven, Conn.*

For more information circle **226** on inquiry card.

HEALTH MONITOR

New "BIC-2 Balanced Ionization Chamber" enables its wearer to judge how much time he has left before becoming seriously or fatally injured by radiation. Instrument "is most definitely NOT in the Geiger counter category," is based upon balancing between a negative-ion current gen-



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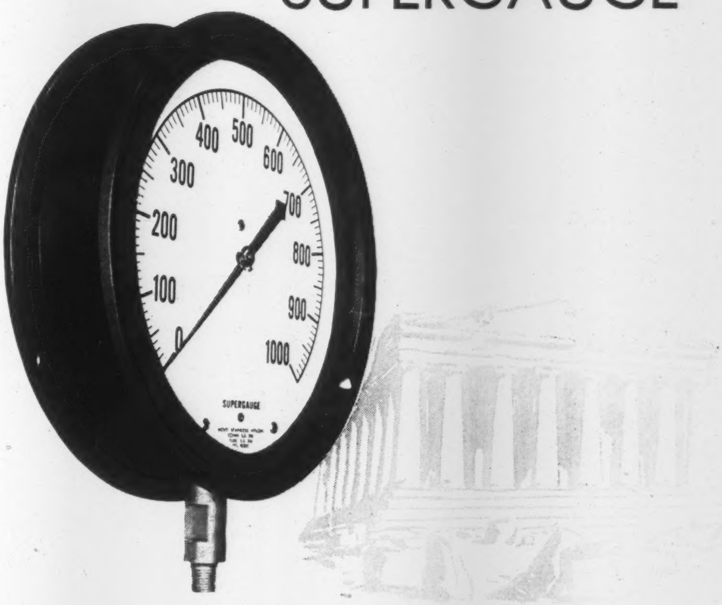

the NEW USG SUPERGAUGE®

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With proper application, the new USG Supergauge will last a lifetime!

SEGMENT—stainless steel, with nylon-faced gear section. Nylon-to-metal bond stabilizes the nylon against expansion and contraction . . . maintains accurate pitch diameter . . . assures proper mesh with stainless steel pinion under severe temperature and moisture conditions.

MONO-UNIT CONSTRUCTION—permits easy removal of complete gauge assembly for inspection and adjustment.

ARC-LOC MOVEMENT—permits all calibration adjustments of gauge assembly from rear without removing dial and pointer.

LEGEND ON DIAL—gives complete description of socket, Bourdon tube and movement material for ready identification.

MICROMETER ADJUSTABLE SELF-LOCKING POINTER—permits accurate repositioning of pointer.

These features are also available in USG Solfrunt Gauges with solid front construction.

Supergauges available in 4½", 6", and 8½" sizes. For complete information on case styles, materials of construction and connections write for Publication 1819.

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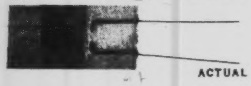
MEASUREMENT
and CONTROL
BROCHURE

RdF STIKON®

RESISTANCE THERMOMETER ELEMENTS

Eliminate Effect of Ambient Air Temperatures



ACTUAL SIZE

Highly-stable RdF Stikons respond to changing temperatures quickly and accurately (to one-half a degree centigrade). Because of the element's thin construction (.005 to .010 inches), and the extremely close proximity of its temperature-sensitive grid to the measured surface, the effect of ambient air temperature is practically nil. When used in a bridge, *an RdF Stikon may easily produce output voltages several hundred times higher than the output of the most sensitive thermocouples.*

SUMMARY OF CHARACTERISTICS

Type	Resistance at 70°F (ohms)	Temperature Range F*
BN-1	81.7	—100° to +300°
BN-3	50.	—100° to +300°
BN-4	200.	—100° to +300°
PN-1	50.	—100° to +180°
PN-2	200.	—100° to +180°
SN-1	100.	—100° to +500°

* For continuous operation — may be used intermittently at higher temperatures. See RdF Stikon Brochure T-54.

Type	Wafer Material	Size (inches)
BN-1	Bakelite	1/2 x 1 1/2 x .005
BN-3	Bakelite	5/16 x 3/4 x .006
BN-4	Bakelite	9/16 x 7/8 x .006
PN-1	Paper	5/16 x 3/4 x .006
PN-2	Paper	9/16 x 7/8 x .006
SN-1	Silicon-Glass	9/16 x 1 7/16 x .010

Types BN-1, BN-3 and PN-1 are marked to 0.2 ohms, while types BN-4, PN-2 and SN-1 are marked to 0.5 ohms.

Arthur C. Ruge
Associates, Inc.

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ARTHUR C. RUGE ASSOCIATES INC.
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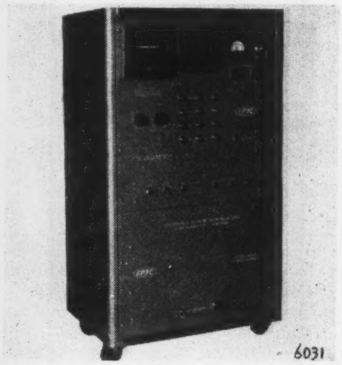
For more information circle 77 on inquiry card.

erated by externally-originating radiation and a positive-ion current from an internal alpha transmitter. It will function up to 180 hours on hearing-aid batteries.—*Librascope, Inc.*, 808 *Western Ave., Glendale, Calif.*

For more information circle **227** on inquiry card.

HIGH-SPEED SCALERS

New "Models 4104 and 4124" 10-Mc scalers have a binary or decade scale of 4096 or 1,000 respectively, or larger if desired; are specially designed for high-speed nuclear and general counting. Five-digit electrical reset register with any count predeterminable.—*Electrical and Physical Instrument Corp.*, 42-19 *27th St., Long Island City* 1, *N. Y.*



For more information circle **228** on inquiry card.

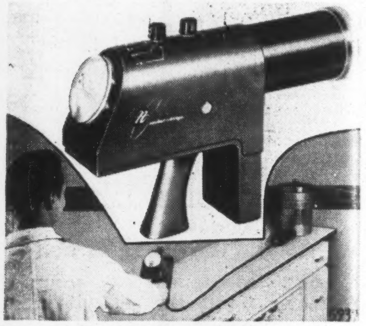
PROSPECTING EQUIPMENT

New "Model DP-165 Scintillation Counter Gamma Hole Logging Probe and Ratemeter" includes complete instrumentation (except recorder) for use with hoisting equipment for uranium detection, stratigraphy, lithology and potentially for in-hole spectrometry.—*Mount Sopris Instrument Corp.*, 1320 *Pearl St., Boulder, Colo.*

For more information circle **229** on inquiry card.

SURVEY METER

New model of wartime "Cutie Pie" determines amount of radiation which workers are receiving; monitors containers for excess radiation; can be used for remote monitoring, for civil defense, industrial radiography, etc. Three direct-reading ranges: 0-25/250/2500 milliroentgens/hr.—*Nuclear Instrument & Chemical Corp.*, 229 *W. Erie St., Chicago* 10, *Ill.*



For more information circle **230** on inquiry card.

LABORATORY EQUIPMENT

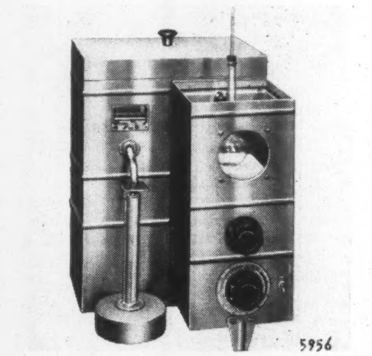
SOURCE EXCITATION UNIT

New Source Excitation Unit is a simplified power source for spectrographs used in industrial and educational laboratories. It instantly provides ac or dc arc power, or a high-voltage spark for burning spectrograph samples of all kinds, by rotation of a selector switch or control panel. Unit is built as a table: most spectrographs can be placed directly on it.—*Bausch & Lomb Optical Co.*, 635 *St. Paul St., Rochester, N. Y.*

For more information circle **231** on inquiry card.

DISTILLATION UNITS

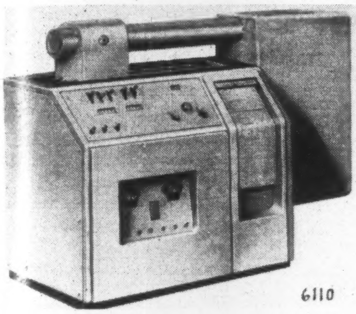
Newly redesigned "Front-View" distillation units, used in determining the distillation range of certain petroleum products, are offered in single, double and four-unit sizes for ice-refrigerated standard distillations and for water-cooled gas-oil distillations; also in four- and six-unit assemblies with single mechanically-refrigerated condenser troughs.—*Precision Scientific Co.*, 3737 *W. Cortland St., Chicago* 47, *Ill.*



For more information circle **232** on inquiry card.

RAMAN SPECTROPHOTOMETER

New "Model 81" has increased speed, accuracy, and convenience. A complete Raman spectrum of benzene, for example, can be made in 5 minutes on as little as 0.1 ml of sample, yet retain good accuracy.—*Applied Physics Corp.*, 362 *W. Colorado St., Pasadena, Calif.*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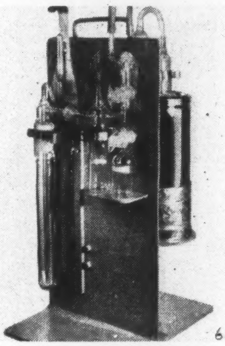
For more information circle **233** on inquiry card.

DISTILLATION TRAIN

New Distillation Train in a single unit features low temperature trap with a Dewar and a 20-mm fritted disc manostat, manometer with a mirror Metric scale; is ready for use at all times; saves bench space.—*Delmar Scientific Labs*, 1551 *N. Cicero Ave., Chicago, Ill.*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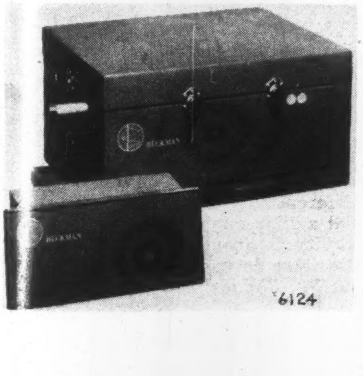
For more information circle **234** on inquiry card.

INFRARED ANALYZER

New "Model 176" continuous infrared dispersive-type analyzer designed to continuously monitor and control liquid and gaseous process streams is especially suited for pilot plant op-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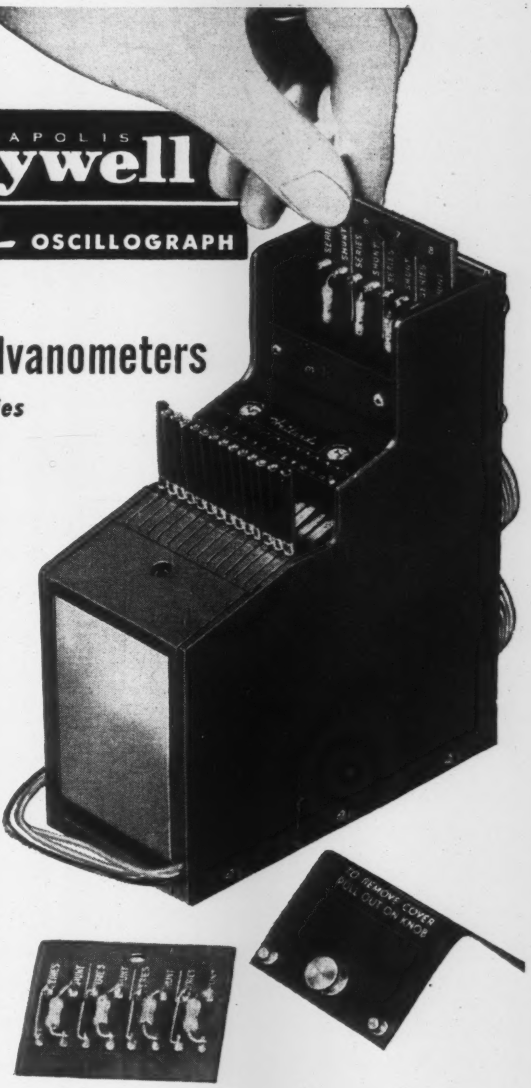
MINNEAPOLIS **Honeywell**

Heiland OSCILLOGRAPH



Recording Galvanometers

with higher frequencies
higher sensitivities

The new Heiland Series 700C Recording Oscillograph gives you an increased number of channels, extended frequency range, greater sensitivities, and operates throughout a broader temperature range because of this new magnet assembly and subminiature galvanometers.

- **The series shunt-resistor networks—which with their connectors form a part of the completed magnet assembly—are easy to insert from the operating surface of the oscillograph.**
- **Galvanometers are available in frequencies as high as 5000 cps, yet they need only 34 milliamperes per inch deflection. The lower frequencies require as little as 4 microamperes per inch deflection.**
- **For your recording requirements, no matter how complex, select the new Heiland 700C Recording Oscillograph.**

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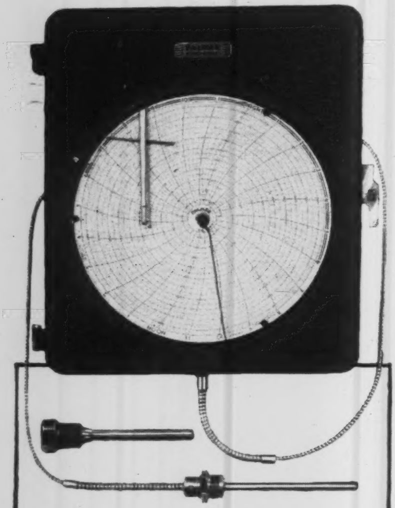
PALMER
MERCURY ACTUATED
recorders

Into this modern Mercury Actuated Recorder has gone all the skill of Palmer master craftsmen.



Readings are clearer, smoother and more precise than ever thought possible. In fact readings are so amazingly improved that maintenance is never needed under normal uses.

Recording Thermometers feature twelve inch die-cast aluminum case with black wrinkle or white satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges —40 to 1000°F, or Equivalent in °C.

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Cincinnati 12, O.

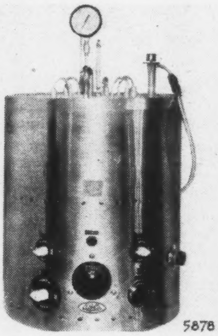
For more information circle 79 on inquiry card.

eration, also for controlling product purity from a fractional distillation column. Dispersive design is based on that developed by Herscher and Wright of Dow Chemical Co. Three basic components: detector (a single-beam spectrometer with slit width and wavelength adjustment controls in an explosion-proof case), amplifier and recorder. Available for monitoring two components: a double wavelength attachment that can continually or selectively alternate wavelength setting between two fixed wavelengths.—*Beckman Division, Beckman Instruments, Inc., Fullerton, Calif.*

For more information circle **235** on inquiry card.

GUM-IN-FUELS TESTER

New aluminum-block constant-temperature bath is suitable for determining existent gum in aviation and motor gasoline using air pre-heated to 320°F, or for jet fuels using steam as vaporizing medium at a superheated steam temperature of 450°F. Standard apparatus is a 6-unit model, complete with 6 beakers, thermometers, flow gage, and built-in superheater.—*The Emil Greiner Co., 20-26 N. Moore St., New York 17, N. Y.*



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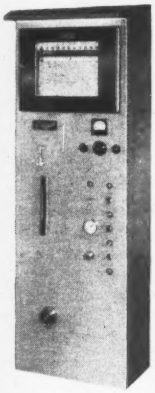
For more information circle **236** on inquiry card.

VAPOR-PHASE CHROMATOGRAPHY APPARATUS

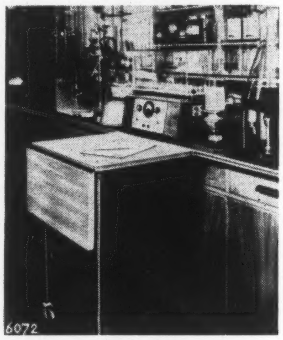


New "Chromacon," for primary analysis where its accuracy (from 1% to 4% of component) is adequate, supplements distillation methods in resolving fractions not separable by distillation alone. It is available separately or in combination with either "Thermocon" automatic recording low-temperature apparatus or "Hyper-Cal" automatic recording high-temperature analytical distillation apparatus.—*Podbielniak, Inc., 341 E. Ohio St., Chicago 11, Ill.*

For more information circle **237** on inquiry card.

MOBILE BENCH UNIT

New model of "Rolla-Bench" gives 5 sq ft of extra working space and rolls along bench on guide rail to give this extra space when and where it's needed.—*Palo Laboratory Supplies, Inc., 81 Reade St., New York 7, N. Y.*

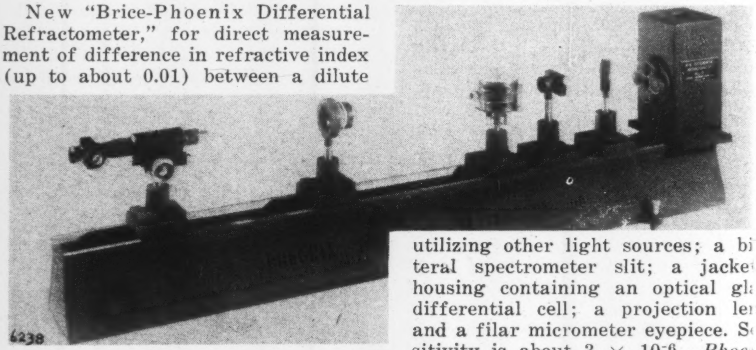


6072

For more information circle **238** on inquiry card.

DIFFERENTIAL REFRACTOMETER

New "Brice-Phoenix Differential Refractometer," for direct measurement of difference in refractive index (up to about 0.01) between a dilute solution and its solvent, comprises a mercury lamp and monochromatic filters; a semi-transparent mirror for utilizing other light sources; a bilateral spectrometer slit; a jacketed housing containing an optical glass differential cell; a projection lens; and a filar micrometer eyepiece. Sensitivity is about 3 × 10^{-6}.—*Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia 40, Pa.*

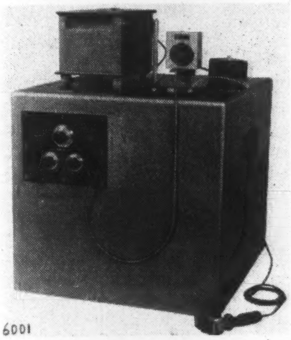


6238

For more information circle **239** on inquiry card.

CRYOSCOPE

New "Fiske Cryoscope" measures freezing points to 0.001 C° on samples down to 0.2 ml in one minute

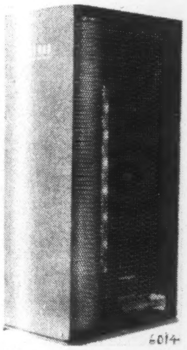


6001

over range of 20°C to −30°C; yields large savings in product and/or taxes; can be permanently calibrated for direct reading.—*Advanced Instruments, Inc., Needham 92, Mass.*

For more information circle **240** on inquiry card.

AIR DRYER



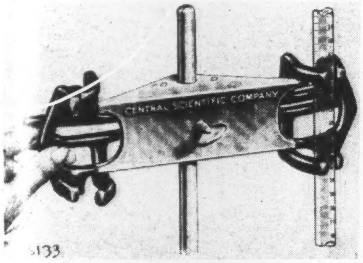
6014

New air dryer, originally developed for use with a precision infrared spectrophotometer, delivers air with less than 1% relative humidity; employs activated alumina as drying agent; will deliver 100 scfh all day long, then regenerate automatically at any selected time. —*Beckman Div., Beckman Instruments, Inc., Fullerton, Calif.*

For more information circle **241** on inquiry card.

DOUBLE BURETTE CLAMP

New clamp holds a pair of burettes parallel for making titrations; features double-action grips, which hold



5133

each burette at both top and bottom, and which can be sprung together or singly.—*Central Scientific Co., 1700 Irving Park Rd., Chicago, Ill.*

For more information circle **242** on inquiry card.

STIRRING-BAR RETRIEVER

New "Retriever" obviates need of emptying contents of container to

NOW!

control that vital operation ... automatically!

Speed up production
Cut down on waste
Save valuable time

Automation can give you the jump on competition ... and selection of the "right" industrial time controls can make a big difference in increased efficiency and reduced manufacturing costs. The AEMCO units listed below are just a few of the standard models which today occupy an important place in the nation's industry. Should you have a particular design problem which would not permit the application of a standard unit, write to our Engineering Department for information and quotations on your specialized problems.

AEMCO

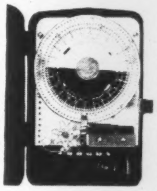
Manual, Automatic Re-set, or Continuous Cycling

INDUSTRIAL TIME CONTROLS

More "on" and "off" operations per cycle!

CYCLE MASTER TIME SWITCH

Not just a time switch, the "Cycle Master" may be used as a timer as well. Up to 48 separate "on" and "off" operations per cycle—available in 1, 12, or 24 hour cycling models. Time intervals between "on" and "off" operations of 37½ seconds on the 1 hour units adjustable up to 15 minutes on the 24 hour units by inserting pins. With or without skip-a-day feature in 10 and 20 amp. capacities. Also available with slide trippers; however, number of "on" and "off" operations per cycle will be reduced accordingly.

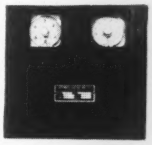


AR & MAR AUTOMATIC RE-SET TIMERS

Neat, compact, easy-to-set. MAR series available in cycles from 30 seconds up to 1 hour. The AR unit is available in cycles from 1 hour up to 96 hours. 10 amp. capacity — all models feature rapid re-cycle.

MARA AUTOMATIC RE-SET TIMERS

Actually two inter-connected adjustable timers, the MARA Series units permit varying not only the "on" and "off" periods, but also the length of the complete cycle. Units may be varied, for example to "on" 6 hours—"off" for 2 hours. This series may be supplied to operate in cycles from 10 seconds to 108 hours. Should either open or closed circuits require a short interval, one timer is provided with an extremely short time cycle for precise accuracy. Steel case measures 8"x 5"x4½"—equipped with a lockable metal hasp.



WRITE TODAY

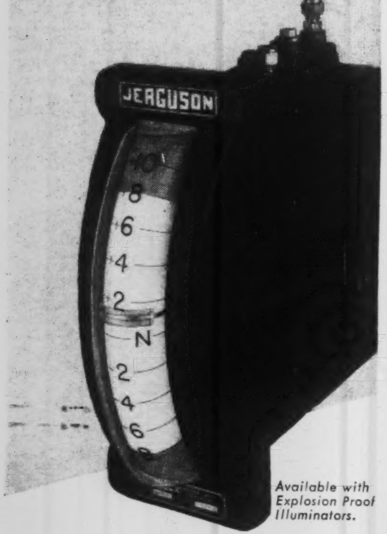
If you have a particular design or control problem we will be happy to help you solve it with a standard or custom AEMCO timer. For complete information write to:

AEMCO

AUTOMATIC ELECTRIC MANUFACTURING CO.
45 STATE STREET • MANKATO, MINNESOTA
TIME SWITCHES • INTERVAL TIMERS • SIGN FLASHERS • RELAYS • CONTACTORS

For more information circle 80 on inquiry card.

Jerguson
TRUSCALE
Remote Reading Gages



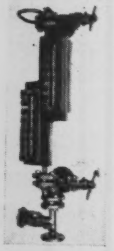
Available with Explosion Proof Illuminators.

Full 180° Visibility Accuracy to ½ of 1%

You get full 180° visibility with the new Jerguson Truscale Gages with the Convex Scale. Scale markings are directly on the convex face and the indicator goes clear around the convex surface. You can bring your liquid level down to the control room floor, or other remote point . . . and can see it from anywhere in the room . . . can check a whole line-up of Truscales with one look from any point.

Truscale is really accurate too . . . sensitive to ½ of 1% of scale reading. Simple trouble-free construction. Available with signal horns, lights and up to six repeaters for other auxiliary points.

New design boiler water gage gives maximum visibility



Jerguson's unique offset single piece gage chamber gives you more inches of visibility with no blind spots. Special valve with horizontal loop keeps the strain off the gage under varying conditions of expansion and contraction.

Send for complete data on Jerguson Convex Scale Truscales . . . and Boiler Water Gages.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Offices in Major Cities
Bailey Meters & Controls, Ltd., London, Eng.
Controle Bailey, Paris, France

For more information circle **81** on inquiry card.

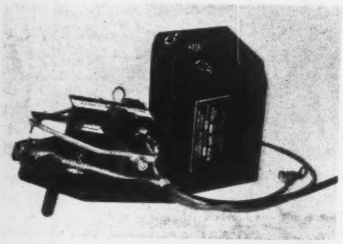
retrieve stirring bars used with magnetic stirrers: it is immersed in container and bar comes out with it. Device is made of flexible chemically-resistant polyethylene tubing, 13" long by 5/16" dia; permanent magnet sealed in one end; eyelet in other end.—*Will Corp., Rochester 3, N. Y.*

For more information circle **243** on inquiry card.

SHOP EQUIPMENT, AUTOMATION

WELDING HEAD

New "Model WHD 5" permits reliable spot-welding of subminiature parts down to 0.0003" thick. Rigid welding arm (moving mass of less than ¾ oz.) mounted in radial ball bearings, is balanced in itself, so that pressure on electrode is only that exerted by leaf spring. This is claimed to result in exceptionally fast follow-up forging action. Unit can be used with any small welding power supply with suitable timer, or with maker's special stored energy power plants.—*Ewald Instruments, 93 Nassau St., New York 38, N. Y.*

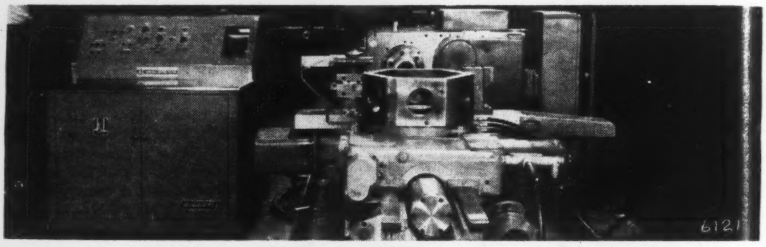


For more information circle **244** on inquiry card.

JIG BORER

New "Hauser 3BA" retains sensitivity and ease of control of "2BA" but has many new features to in-

PUNCHED-TAPE-TYPE MACHINE OR PROCESS CONTROLLER



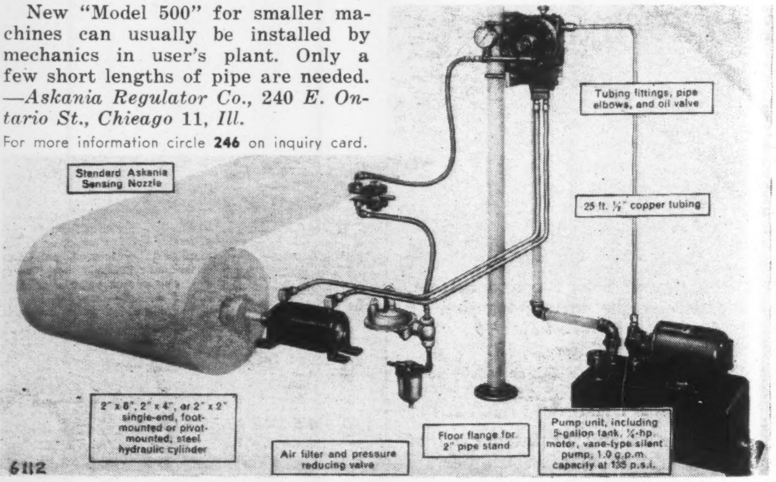
New "Binotrol" punched-tape control system is for automatic operation of machine tools, valves, etc. Operating principle is digital-to-analog. System contains few vacuum tubes; circuitry it composed mainly of telephone-type relays. Example: On a turret lathe (photo) system controls 16 spindle speeds, turret indexing, cross slide indexing, coolant, hood, chuck and bar feed. All tool motions are completely tape controlled. Lead screw accuracy is controlled to within 0.001" and cross slide motion to 0.0005". Machine can also be jogged into position by push-button control and manual cranks.—*Barnes Engineering Co., Stamford, Conn.*

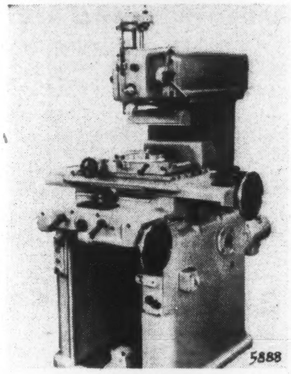
For more information circle **245** on inquiry card.

EDGE GUIDE CONTROL FOR PRESSES, SLITTERS, ETC.

New "Model 500" for smaller machines can usually be installed by mechanics in user's plant. Only a few short lengths of pipe are needed.—*Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.*

For more information circle **246** on inquiry card.


Standard Askania Sensing Nozzle
Tubing fittings, pipe elbows, and oil valve
25 ft. ½" copper tubing
2" x 8", 2" x 4", or 2" x 2" single-end, foot-mounted or pivot-mounted, steel hydraulic cylinder
Air filter and pressure reducing valve
Floor flange for 2" pipe stand
Pump unit, including 5-gallon tank, ¼-hp motor, vane-type silent pump, 1.0 g.p.m. capacity at 135 p.s.i.
6112



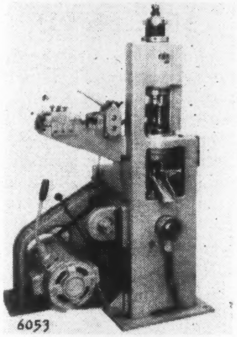
5888

crease range and usefulness: greater boring capacity, greater height adjustment, heavier quill, larger table surface and greater table travel.—*Carl Hirschmann Co., Inc., 30 Park Ave., Manhasset, N. Y.*

For more information circle **247** on inquiry card.

BLANKING PRESS

New Essa "BH-6" 6-ton blanking press, being introduced in U. S., is said to offer "tremendous advantages



6053

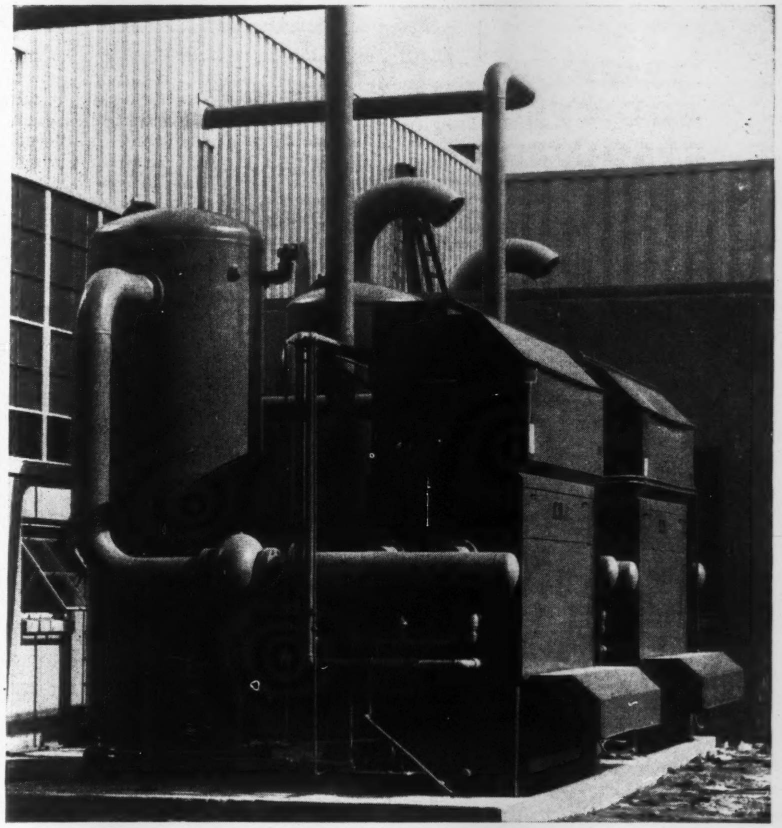
in increased die life, more accurate stroke and tool adjustments, and higher production rates." It is suitable for production of components of instruments, etc.—*Carl Hirschmann Co., Inc., Manhasset, N. Y.*

For more information circle **248** on inquiry card.

GRAPHIC CIRCUIT PRODUCTION UNIT

New "Protomaka," for making production prototypes of graphic circuits, measures 60″ long by 50″ wide; can produce an average circuit in 30 to 40 minutes; can produce circuits up to 10″ by 16″; is said to short-cut

6251



This Niagara Aero After Cooler also cools compressor jacket and intercooler water.

COMPRESSED AIR... Lower in Cost
Dependably Drier and Cooler
Trustworthy for Instrument Use

THE NIAGARA *AERO* AFTER COOLER offers a completely self-contained method replacing both shell-and-tube cooler and cooling tower. It is independent of a large supply of cooling water and consistently reduces compressed air temperatures to below ambient. Its drier air gives you a better operation and lower costs in the use of all air-operated automatic instruments, tools and machines, paint spraying, sand blasting and moisture-free air cleaning.

Direct saving in the cost of cooling water saves the price of the Niagara *Aero* After Cooler in less than two years. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara *Aero* After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter, proven in service on the largest plant utility air systems.

Write for complete information; ask for Bulletin No. 130

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

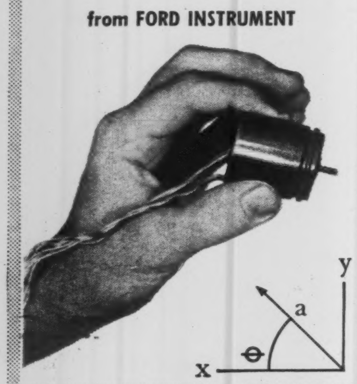
Dept. I. N., 405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities

For more information circle **83** on inquiry card.

TELESYN® 400 CYCLE RESOLVERS

from FORD INSTRUMENT



- STANDARD RESOLVERS in Sizes 15 and 23.
- RESOLVER SYSTEMS incorporating size 23 resolvers, network box and amplifier.
- and SPECIALS designed to the particular application.

Ford Instrument's *Telesyn* Resolvers – precision-built for the extreme efficiency and accuracy of the Company's computers and control systems – are available to meet your *own* quality requirements.

FREE – Fully illustrated data bulletin gives specifications and performance information. Please address Dept. IA.

69A

FORD INSTRUMENT COMPANY
Division of Sperry Rand Corporation
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Ford Instrument's standard components

Rate Generators
Differentials
Servo Motors
Telesyn Resolvers
Integrators
Telesyn Synchros

For more information circle 84 on inquiry card.

circuit and product development time "by weeks and, in many cases, months". To operate, it is plugged into a standard 110-v line, one hose is connected to a cold water faucet and another to a waste drain. Unit produces etched wiring by photographic process. All controls are mounted on panel which divides the two rows of tanks. Each operation is regulated by controls immediately above its particular section.—*Printed Electronics Corp., 15 Willow St., Natick, Mass.*

For more information circle **249** on inquiry card.

ENGRAVER BENCH

6045

New heavy-duty steel bench, constructed to hold maker's "Model D2" Engraver, is designed for user's convenience. All functional parts of pantograph are comfortably within reach of seated user.—*Green Instrument Co., 385 Putnam Ave., Cambridge, Mass.*

For more information circle **250** on inquiry card.

INDUCTION GENERATOR

6057

New "Ther-Monic Model 50 WS" induction generator for wire stripping, when used in combination with any conventional automatic wire stripping machine, will pre-bond ends of tinned stranded wire to #26 gage, virtually eliminating hand twisting and dipping each lead prior to soldering operations. On solid or non-tinned wires it loosens most plastic insulations in area to be stripped. It can be instantly converted to an induction heater for hermetic sealing, etc.—*Induction Heating Corp., 181 Wythe Ave., Brooklyn 11, N. Y.*

For more information circle **251** on inquiry card.

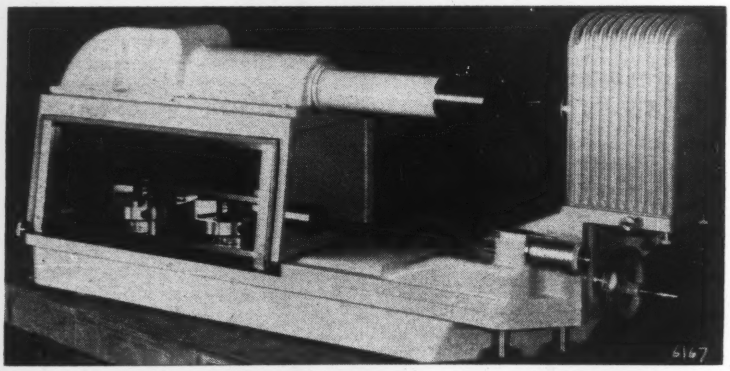
TUBE BENDER

New "Exactol" tube bender is a crank-operated worm gear device for easy, manual bending to exact tolerances. It will readily handle annealed or 1/8H cold drawn stainless steel tubing; enables the operator to produce bends up to 180° in one continuous operation without fatigue.—*Tube & Hose Fittings Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.*

For more information circle **252** on inquiry card.

DIMENSIONAL GAGING, INSPECTION, etc.

GAGE BLOCK INTERFEROMETER

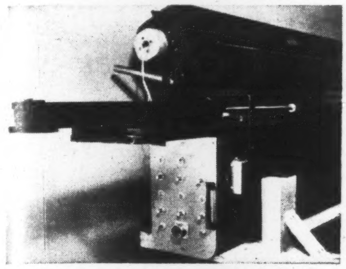

6167

New National Physical Laboratory type interferometer (made by Hilger of England) for absolute measurement of gage blocks to an accuracy of one microinch can accommodate 36 gage blocks at one time in a temperature-insulated case; permits choice of best radiations from varying light sources; enables determination of length as well as flatness and parallelism of faces. Gages are measured in condition in which they are used—wrong onto a platen—hence no need for special support or compensating calculations.—*Engis Equipment Co., 431 So. Dearborn St., Chicago 5, Ill.*

For more information circle **253** on inquiry card.

PINHOLE DETECTOR

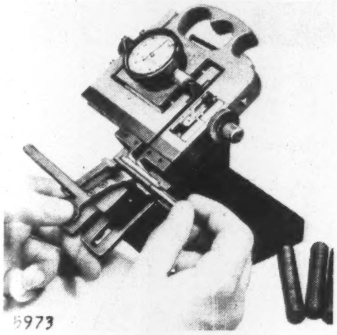
Newly redesigned pinhole detector for strip steel has a sensitivity five times that of former model. Under actual operating conditions on cold rolled strip steel, it will detect holes down to one mil diameter in opaque strip measuring 10 mils or less in thickness; will function with maximum sensitivity at strip speeds up to 2,000 fpm; has a potential of more than 6,000 fpm.—*General Electric Co., Schenectady 5, N. Y.*



For more information circle **254** on inquiry card.

LEAD CHECKER

New lead checker, utilizes "Versa-Dial" gage, with jaws carrying "V" edges and capable of being attached at any desired spacing. A spring-loaded lever snugs workpiece against the vees, and lead variation is read directly on indicator graduated in 0.0001".—*Standard Gage Co., Poughkeepsie, N. Y.*



For more information circle **255** on inquiry card.

GAMMA-RAY PROJECTORS

New "Kel-Ray" portable gamma ray projector with advantages over conventional x-ray equipment used in

VENTED-EXHAUST

IS NOW AVAILABLE
on The Welch (Model 1397B)
TWO-STAGE DUO-SEAL® PUMP
at no increase in price . . .

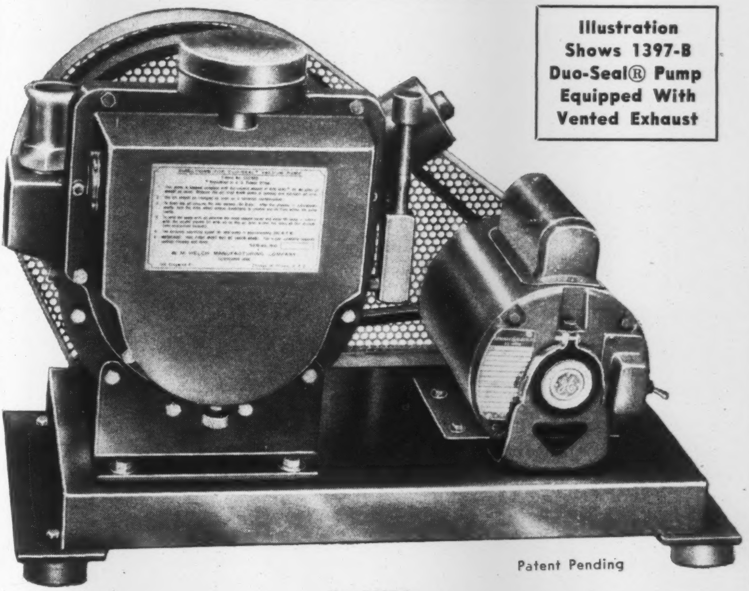


Illustration
Shows 1397-B
Duo-Seal® Pump
Equipped With
Vented Exhaust

Patent Pending

No. 1397-B

- ★ **Vented Exhaust Permits Pumping of Most Condensable Vapors.**
- ★ **Eliminates Use of Traps or Oil Separators in Systems Containing Water or Other Condensables.**
- ★ **Reduce Number of Oil Changes Required.**

VENTED EXHAUST IS AVAILABLE ON ALL TWO-STAGE DUO-SEAL® PUMPS

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Manufacturers of Scientific Instruments and Laboratory Apparatus

For more information circle **87** on inquiry card.

E-I DIGITAL VOLTMETERS

now even easier to use!

DIGITAL VOLTMETER
-1121123

New design features continuous, automatic calibration; eliminates manual adjustments!

This latest improvement in E-I Digital Voltmeters automates precision measurements of AC and DC voltages.

Formerly, to assure precise measurements, instruments had to be calibrated periodically by comparing the reference against internal standard cells. Necessary adjustments were then made manually. These checks and adjustments were time consuming and interrupted the test program.

Now, through new circuit design, calibration of all E-I DC Voltmeters is *continuously* and *automatically* checked and adjusted. The instruments are always in calibration, relieving the operator from the responsibility of making periodic calibration adjustments, and assuring continuous precise measurements.

Your E-I representative has the complete story. Call him today.

FEATURES OF THE NEW E-I DIGITAL VOLTMETERS

EXCELLENT STABILITY—0.01% from 40° to 125° F.

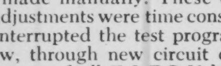
FAST WARM-UP TIME—30 seconds for 0.01%.

DIGITAL READ-OUT—1" numbers, in-line; can be easily read at 30 feet.

WIDE RANGE—0.001 to 999.99 volts.

REQUIRED ACCURACY—±1 digit, or 0.01% of reading and/or 1 digit.

NEW E-I DIGITAL OHMMETER AUTOMATICALLY MEASURES PRECISE RESISTANCE VALUES!



Presents measurements digitally, prevents ambiguous readings. Available in 4- and 5- digit models; 0.1 to 10 megohms range; 0.01% ±1 digit accuracy.

ELECTRO INSTRUMENTS INC
3794 Rosecrans St., San Diego 10, Calif.
Representatives in major U.S.
and Canadian industrial areas.

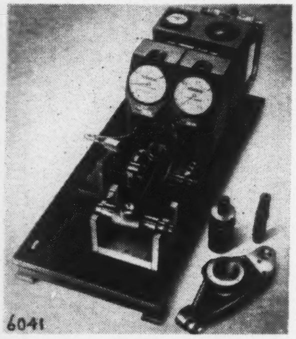
For more information circle **88** on inquiry card.

radiography work is made (by The M. W. Kellogg Co.) in three sizes: 75, 250 and 2,900 lb; is safe to operate; costs a fraction of comparable x-ray equipment used for radiography work; needs no electricity, no control board, no maintenance beyond replenishment of radio-isotope; and can take a picture of 360 degrees.—*Metal & Thermit, 100 E. 42nd St., New York, N. Y.*

For more information circle **256** on inquiry card.

BORE-PARALLELISM GAGE

New "Model A-256 B-6" checks parallelism of two bores in two planes for two different size workpieces. To establish a common axis for the two bores, expanding precision mandrels are placed in each bore and in turn rest in V-blocks; gaging contacts are mounted on frictionless motion transfer units which relay movement of sensitive contacts to "AirProbes," universal air gaging spindles.—*Federal Products Corp., 1144 Eddy St., Providence 1, R. I.*



6041

For more information circle **257** on inquiry card.

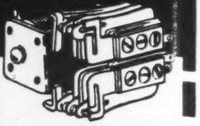
MECHANICAL TESTING

HIGH-ALTITUDE CHAMBER

New "Model 5500 Iono-Chamber" simulates pressure conditions corresponding to altitudes as high as 350,000 ft. One version provides a change from sea level to 150,000 ft (about 100 microns) within 60 seconds and

6063

RELAYS



MINIATURE AIRCRAFT
TELEPHONE TYPE
HERMETICALLY SEALED
SENSITROLS
STEPPING SWITCHES
GUARDIAN • KURMAN
ALLIED • SIGMA • LEACH
and many others

LARGEST STOCK OF RELAYS IN THE WORLD

PRODUCTION QUANTITIES IN STOCK

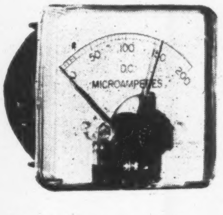
Send for our latest bulletin—I

324 CANAL ST., N.Y.C., 13, N.Y. WAlker 5-96 2
Universal general corp.

For more information circle **89** on inquiry card.

METER-RELAYS

For Sensitive and Accurate Control



RANGES:

0/20 Ua. to 0/50 A.
0/5 Mv. to 0/500 V.

The trip point is adjustable to any point on the scale arc.

These meter-relays are sensitive to changes of as little as 1%. One contact is carried on moving pointer. The other is on a semi-fixed pointer. When two pointers meet contacts close and lock. Holding coil is wound directly over moving coil. Reset can be manual or automatic. Spring action on contacts kicks them apart forcefully. Three sizes of clear plastic case models, 2½, 3¾ and 4½ inches (all rectangular). Two ruggedized and sealed models, 2½ and 3½ inches (round metal case). Contact arrangements: High Limit Single, Low Limit Single or Double (both high and low). Contact rating is 5 to 25 milliamperes D.C.

Suggested circuits for meter-relays and complete specifications including prices are covered in new 16-page Bulletin G-6, which you can get by writing Assembly Products, Inc., Chesterland 10, Ohio.

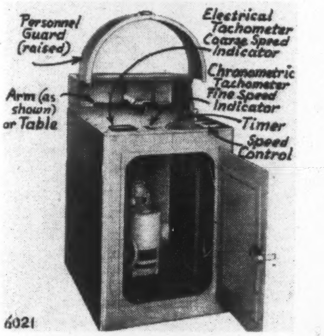
For more information circle **90** on inquiry card.

from 150,000 ft to 35,000 feet in next minute. Cylindrical working space is 18" ID by 30" deep. Normally furnished without temperature or humidity control equipment.—*Hudson Bay Co. Div., Labline, Inc., 3070 W. Grand Ave., Chicago 22, Ill.*

For more information circle **258** on inquiry card.

TEST CENTRIFUGE

New test centrifuge or rotary accelerator has 118-to-1260-rpm speed range to provide, for example, 4 to

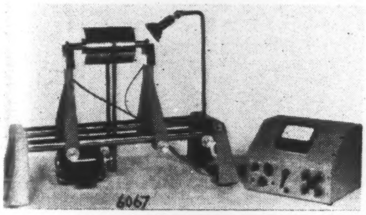

Personnel Guard (raised)
Electrical Tachometer Coarse Speed Indicator
Chronometric Tachometer Fine Speed Indicator
Arm (as shown) or Table
Timer
Speed Control
6021

400 *G* on 9" radius of gyration. Unobstructed space above table is 23" diam and 6" high. For testing electrical components there are 14 slip rings.—*Coleman Engineering Co., Inc., 6040 W. Jefferson Blvd., Los Angeles 16, Calif.*

For more information circle **259** on inquiry card.

DYNAMIC BALANCER

New "Model SU-6" will handle any rotating body from 4 oz to 100 lb and up to 20" max diam. Anyone can

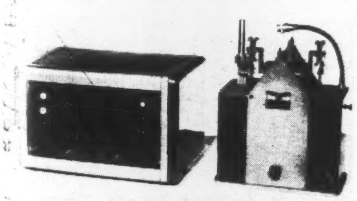


learn to use it in less than an hour. It will balance fans, armatures, blowers, pulleys, crankshafts, etc.—*Micro Balancing, Inc., Garden City Park, N. Y.*

For more information circle **260** on inquiry card.

SIMULATION TABLE

New "Model 10B" is a single-degree-of-freedom roll table for angularly displacing gyros and acceleration pickups, either statically or dynamically. It features a threshold of less than 5 microradians and a nat-



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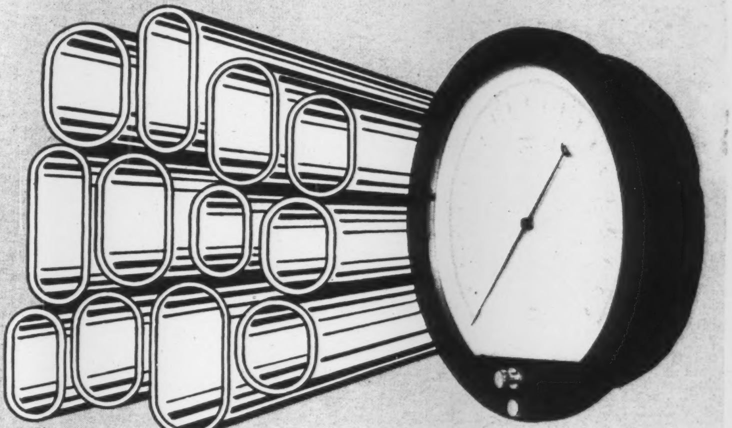

Where highly accurate results are required design considerations such as the depth — width ratio of the Bourdon Tube section are of paramount importance.

Extreme fiber stress resulting from improper design of the tube may render an apparently good instrument completely undependable.

At the Heise Laboratories, mathematical solutions for determining the size and shape of Bourdon Tubes for specific use are augmented by years of research and tests on various types of tubes to assure correct stress distribution.

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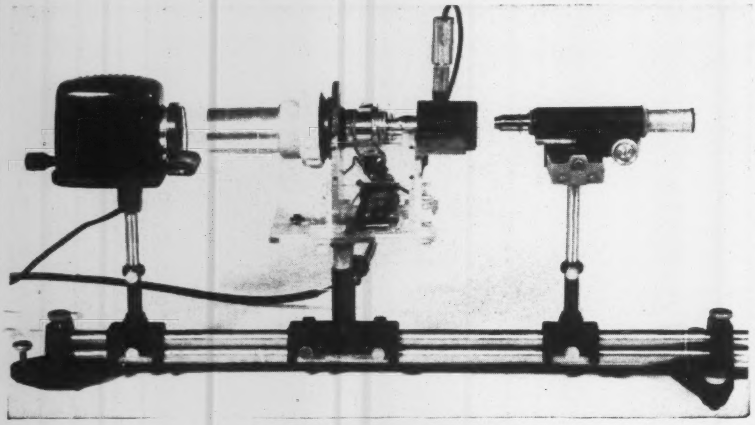

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ural frequency greater than 15 cps. In conjunction with analog computers it makes "flight testing" of a complete aircraft or missile stabilization system possible on the ground. In addition, it can be used as an oscillating table to determine frequency response and threshold characteristics of high-performance gyros and acceleration pickups.—*Micro Gee Products, Inc., Dep't I&A, Box* 1005, 6100 *W. Slauson Ave., Culver City, Calif.*

For more information circle **261** on inquiry car .

STRAIN-GAGE POWER SUPPLY

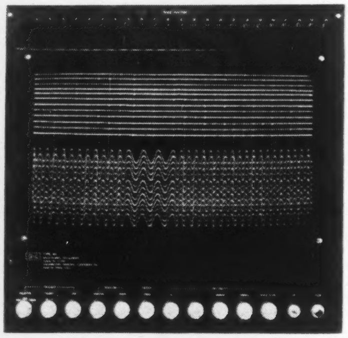
New hermetically-sealed "Bulletin M562," for operation of strain gages and telemetering equipment in ai craft systems, weighs 6-lb; supplies 5 v at 1 amp. Ac input 105 to 125 , single phase, 380 to 420 cps; continuous duty cycle; externally mounted voltage-divider controls. Available immediately from stock.—*Perkin Eng neering Corp.,* 345 *Kansas St., El S gundo, Calif.*

For more information circle **262** on inquiry car .

ELECTRICAL TESTING

24-TRACE CATHODE-RAY OSCILLOSCOPE

New "Model MO" uses a 21" picture tube for direct viewing; presents information by intensity modulation of a 5000-cps raster. Frequency response is useful to 500 cps on all 24 traces with one electron-gun. Each trace can cross over other traces, is limited in amplitude only by size of CRT, has its own position control. A special "window" control permits a portion of sweep to be accelerated for careful examination. ★Auxiliary "Event Pre-Selector" puts 0.1- and 0.01-sec timing lines over 'scope, and triggers sweep after an adjustable delay period fo lowing initial pulse.—*Southwestern Industrial Electronics Co.,* 2831 *Post Oak Rd., Houston* 19, *Texas.*



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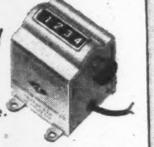

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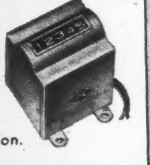

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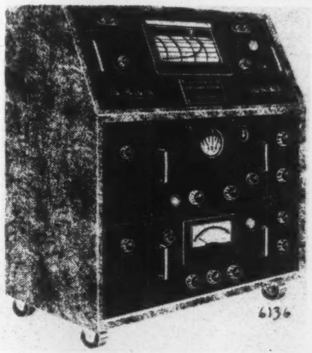
AUTOMATIC IMPEDANCE PLOTTER

New "Automatic Impedance Plotter" is a unique instrument for instantaneous recording of real and imaginary components of impedance as a function of frequency, temperature or other variables. It is a practical production control tool as well as a research instrument. Frequency range 10 cps to 100 kc; accuracy of 2%; resistance range 0 to 10,000 ohms; reactance range ± 10,000 ohms.—*Chesapeake Instrument Corp., Shadyside, Maryland.*



For more information circle **264** on inquiry card.

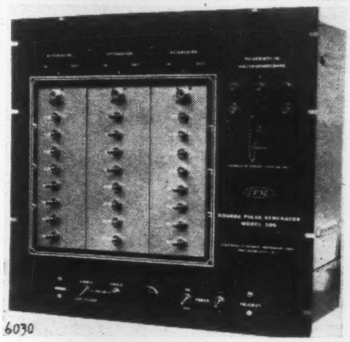
NOISE-FIGURE METER

New "Auto-Node" makes possible automatic production-line and developmental-test noise figure measurements from 5 to 26,500 Mc with continuous interpolation over VHF, UHF and microwave frequencies. Two models: "Model TV"—frequency range: 5-220 Mc; IF strip 20 or 40 Mc; extra IF strips available 300 ohm output balanced; 12-channel selector switch; noise figure range 0-24 db. "Model Radar"—two IF strips—30 and 60 Mc; other IF's available; IF noise figure: 0-7 db; will also operate in conjunction with maker's "Mega-Node Sr." to cover frequency range 10-3000 Mc.—*Kay Electric Co., 11 Maple Ave., Pine Brook, N. J.*

For more information circle **265** on inquiry card.

MILLIMICROSECOND SQUARE-PULSE GENERATOR

New "Model 300" is a new basic test and calibration instrument which generates square pulses of one millimicrosecond rise time and widths



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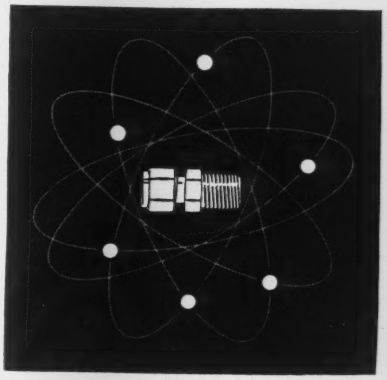

From aluminum to "Zytel" there's a Swagelok answer to your fitting problems. The new Swagelok Tube Fittings of "Zytel" are for use with plastic tubing in applications where corrosion is a problem. They are the first to be made in a complete range of shapes that include elbows, tees, reducers and adapters.

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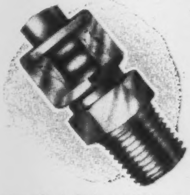

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varying from 0.001 to 0.1 microseconds, selectable on front panel. Longer pulses to several microseconds can also be provided. Three or more separate pulse outputs can be independently varied in amplitude in 1-db steps over range of 100 to 0.006 volts into low-impedance cables (50 to 200 ohms). Each output can also be independently delayed if desired.—*Electrical and Physical Instrument Corp., 42-19 27 St., Long Island City* 1, *N. Y.*

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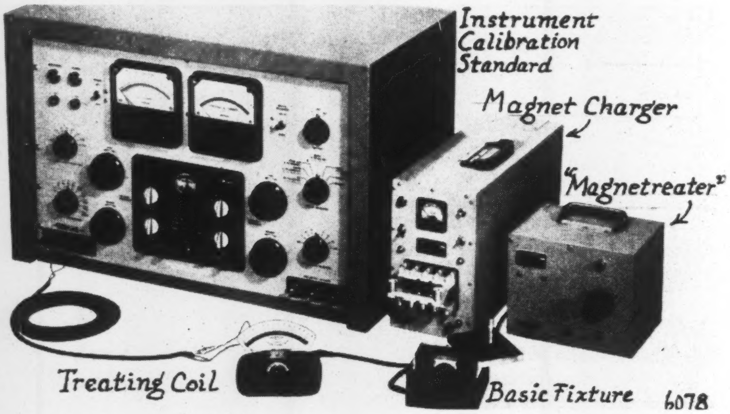
CALIBRATION AND ADJUSTMENT EQUIPMENT

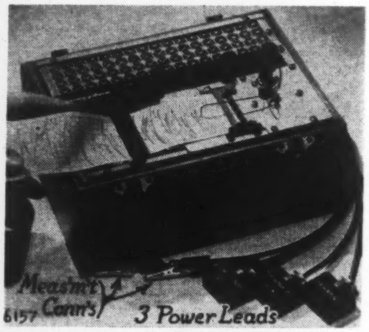


New combination of units and accessories forms a complete package for effectively charging, treating and calibrating electrical indicating instruments. ★New "Model 829 AC-DC Instrument Calibration Standard" can be used by non-technical personnel; comes with "Autodex Calibration Chart" showing comparison of all ranges to basic standards recently set by NBS. Guaranteed accuracy of 0.5% obtainable over all seventy-seven ranges when using chart. Frequency of output on ac ranges is that of power source which may be between 50 and 400 cps. ★New "Model 107A Magnet Charger" charges all kinds and shapes of permanent magnets in common use Dual output range: 12,000 and 24,000 amps. Many magnets can be charged directly on front-end assembly; special adapters available. ★New "Model 889A Magnetreater" quickly treats saturated instrument magnets to any desired level, including new core type mechanisms. It keys "Magnet Charger" discharge circuits at a constant rate of about 80 pulses per minute. A Variac regulates power output level in treating coil. ★New "H-7010-1 Treating Coil" (2½" x 4½") standard equipment, also available in sizes 3" x 6" and 4" x 8". ★New "XD-4128 Basic Fixture" handles new core type meter magnet mechanisms. Associated "G" type inserts also available, as well as various fixtures, keepers, adapters and accessory items.—*Radio Frequency Laboratories, Inc., Powerville Road, Boonton* 13, *N. J.*

For more information circle **267** on inquiry card.

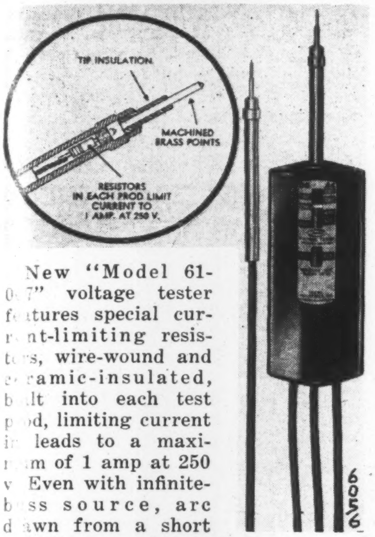
DIRECT-WRITING OSCILLOGRAPHS

Two new models of "Record-a-meter" light-weight (12-lb) direct-writing oscillographs, "Model RA-1000" (sensitivity 200 mv/cm) and "RB-1000" (10 mv/cm), are just about as versatile as is possible for a single-stylus oscillograph to be. Both feature unusual conveniences; can be used in vehicles and aircraft as well as labs; can be quickly connected to a pickup or across instrument terminals; use either conventional ink-type paper or "Teledeltos" electrosensitive paper; can be operated from 115-vac line, from storage batteries, or from heavy-duty dry batteries, by changing power leads. Standard chart speed 15 cm/minute (others available), or an inexpensive accessory makes chart travel represent a function other than time for *"X-Y"* records. Other optional accessories include a chart-paper take-up mechanism, stimulous-marking stylus, remote switching of stylus voltage and timing motor, and an alarm or automatic-control switch.—*Douglas & Gierens, Inc.*, 5516 *Cahuenga Blvd., N. Hollywood, Calif.*



For more information circle **268** on inquiry card.

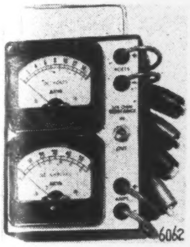
VOLTAGE TESTER



New "Model 61-0 7" voltage tester features special current-limiting resistors, wire-wound and ceramic-insulated, built into each test prod, limiting current in leads to a maximum of 1 amp at 250 v. Even with infinite-bass source, arc drawn from a short at 250 va would not endanger personnel or equipment.—*Ideal Industries, Inc., 1415 Park Ave., Sycamore, I*

For more information circle **269** on inquiry card.

AUTOMOTIVE-VEHICLE SYSTEM TESTER



New "Model G-224 Volt-Amp Tester" checks voltage and current regulators, as well as entire primary electrical system, of all 6- or 12-v automotive vehicles. All tests are said to be made in accordance with original equipment manufacturers' recommended procedure.—*King Electric Equipment Co., Cleveland 5, Ohio.*

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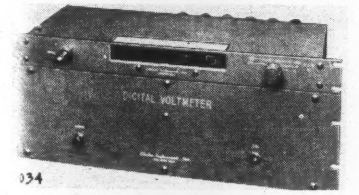
ELECTRICAL INSTRUMENTS

Ac-Dc DIGITAL VOLTMETER

New "Model 4500" (4 digits) and "Model 3500" (3 digits) incorporate unique in-line read-out with 1" high



numerals. Dc accuracy of both models is one digit. Ac accuracy: "Model 4500" 0.1% of reading or 2 millivolts; "Model 3500" 0.25% of full scale. Readings give true value of in-

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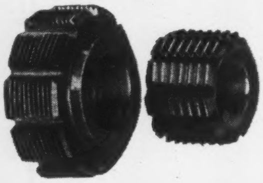
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put wave shape with virtually zero phase shift error. Range is indicated by decimal position. Ac range switching is manual; dc automatic.—*Electro Instruments, Inc., 3794 Rosecrans, San Diego, Calif.*

For more information circle **271** on inquiry card.

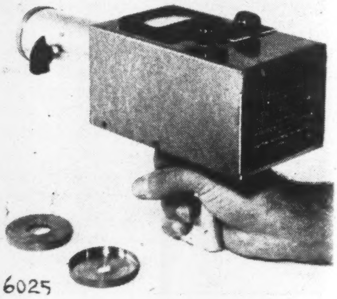
TRANSISTORIZED VOLTMETER

New "Model [illegible]-21" portable voltmeter covers frequencies from [illegible]0 cps to 1 Mc; is battery powered; weighs 5 oz; is stable at temperatures from 0° to 120° F; is transistorized and has printed circuits. Peak sensitivity is 0 to 1 mv and any of 12 decade (10db) ranges can be switched.—*Alto Scientific Co., 855 Commercial St., Palo Alto, Calif.*

For more information circle **272** on inquiry card.

ELECTROSTATIC VOLTMETER

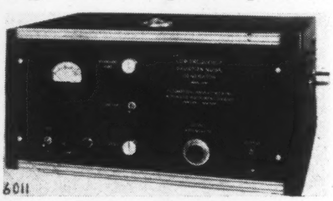
New Electrostatic Voltmeter (developed by Institute of Textile Technology) detects and measures electrostatic charges, can be aimed like a gun; is extremely sensitive but has provisions to reduce sensitivity by factors of 10 or 100.—*Custom Scientific Instruments, Inc., Kearny, N. J.*



For more information circle **273** on inquiry card.

GAUSSIAN-NOISE GENERATOR

New "Low Frequency Gaussian Noise Generator" provides a random voltage whose amplitude probability distribution is gaussian to within 1%. Output frequency spectrum flat to within 1 db from dc to 27 cps in standard model (can be modified on special request). Output voltage vari-

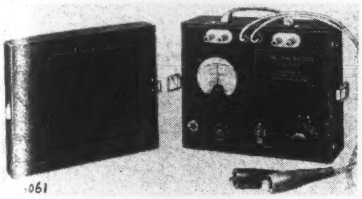


able up to 5 v rms, regulated to within 0.1 db.—*Automatic Instrument Div., Automation Labs, Inc., 517 W. 207th Street, New York 34, N. Y.*

For more information circle **274** on inquiry card.

LOW-RESISTANCE BRIDGE

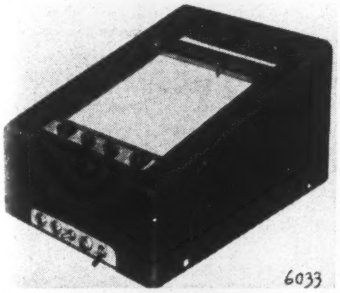
New "KS-2119 Low Ohm Bridge" is a self-contained portable Wheatstone Bridge with null indicator, precision voltage-dividing and calibrating resistors, balancing control, and battery box. Main arm has ten turns of 10 divisions each, giving a total of 100 divisions: four ranges (0-0.1/1/10/100 ohms) reading to 0.0001 ohm on low range. Galvanometer indicates resistance values directly. Over-all bridge accuracy 0.25% at normal requirements.—*Kell-Strom Tool Co., Inc., Wethersfield, Conn.*



For more information circle **275** on inquiry card.

X-Y RECORDER

New 8½" x 11" *X-Y* recorder features: flat-bed presentation; pen assembly adjusts to accommodate a full pad; pen speed ½-second full scale; "jitter" eliminated through suppression of 60- and 120-cycle pickup; eleven scale ranges from 5 mv to 500 v full scale.—*Electro Instruments, Inc., 3794 Rosecrans, San Diego 10, Calif.*

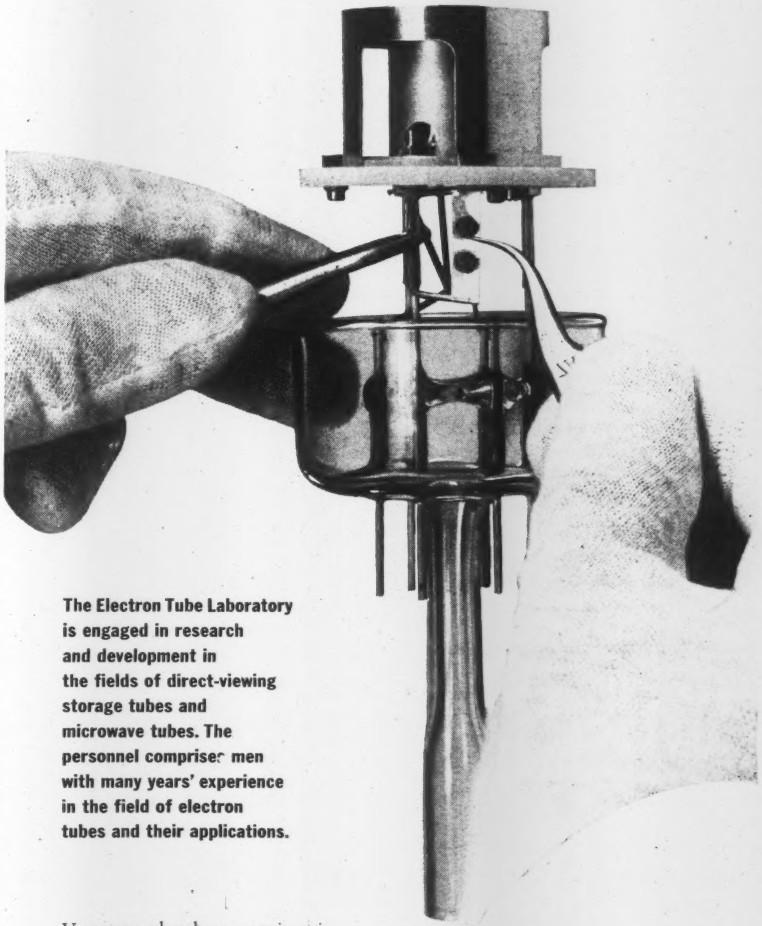


For more information circle **276** on inquiry card.

ELECTR-INSTRUMENT ACCESSORIES

RESISTANCE DECADE

New resistance decade featuring accuracy of better than 0.1% of each resistance increment has seven dial steps of 0.1 to 100,000 ohms. Decades are available with each dial having nine or ten steps. Resistance coils are manganin wire, bifilar wound, except 10,000 ohms and over which are low-temperature-coefficient Ni-Cr-Fe alloy. Switches are self-cleaning type



Technical assistants

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The Electron Tube Laboratory is engaged in research and development in the fields of direct-viewing storage tubes and microwave tubes. The personnel comprises men with many years' experience in the field of electron tubes and their applications.

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Microwave Testing
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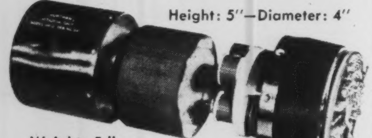
For more information circle **101** on inquiry card.

NORTHAM

Miniature Magnetic

Tape Recorder

Height: 5"—Diameter: 4"



Weight: 5 lbs.

Eight channels of information can be applied simultaneously to a ½-inch tape in the Model MR-1 Recorder (illustrated). This self-contained unit includes transistor timing oscillator and battery power source and operates under axial accelerations up to 500 g. A pre-record carrier system permits direct coupling with D.C. devices such as thermocouples and strain gauge transducers.

MODEL MR-1 SPECIFICATIONS:

Accuracy: ±5% full scale
Sensitivity: 28 millivolts D.C. full scale across 40 ohms impedance
Frequency Bandwidth: 0-250 cps
Timing: 1000 cps transistor oscillator
Running Time: 45 seconds
Applications: Running time, number of channels and recording characteristics are adaptable to meet requirements of applications—including rocket and aircraft flight testing, oil well logging and atmospheric studies.

WRITE FOR BULLETIN NO. IA-101

NORTHAM PRODUCTS INCLUDE . . .
Transducers for pressure, acceleration and displacement measurement and auxiliary electronic equipment for complete systems.

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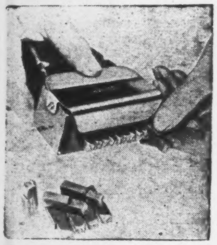
STEEL TYPE HOLDERS

for interchangeable numbering in a straight line. Makes serial or random numbering easy.



To use — just press thumb-clip, insert "Heavy-Duty" Shoulder-Style Steel Type, hold over position and hit with a hammer.

Furnished with round shank for press use also. Other models available for marking convexed or concaved surfaces—***with standard type.***

Write for latest literature and price lists.

The ACROMARK Company
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ELIZABETH 4, NEW JERSEY
"The Original Marking Specialists"

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with four phosphor-bronze spring wipers and detent mechanism.—*Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J.*

For more information circle **277** on inquiry card.

CONSTANT-VOLTAGE SOURCE

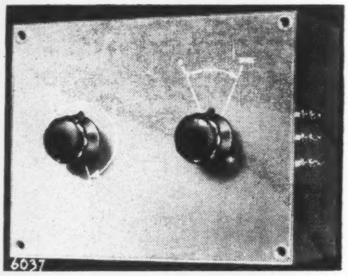
6119

New "k-Volt Standard" is designed to replace standard cell and VR tube as an absolute reference, constant-output working supply or precision voltage regulator in measurement and control applications; uses neither tubes nor moving parts, is unaffected by position, vibration or mechanical shock, and conforms to MIL-E-5272A; operates over ambient temperatures from −55°C to 100°C; is available for operation from 26.5 vdc or 117 vac, with dc output of 6 v or 1 v, at 1 ma or 10 ma.—*Avien, Inc., 58-15 Northern Blvd, Woodside 77, N. Y.*

For more information circle **278** on inquiry card.

VARIABLE DELAY LINES

New custom-built variable delay lines for lab use, computer and radar systems come in a dust-proof case



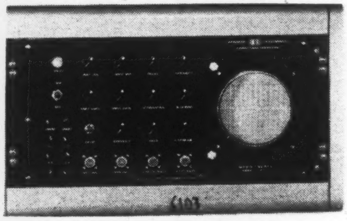
6037

with coarse and fine controls of delay. Delay time, impedance and bandwidths meet individual specs.—*ESC Corp., 534 Bergen Blvd, Palisades Park, N. J.*

For more information circle **279** on inquiry card.

OSCILLOSCOPE MEMORY

New "Memo-Scope" can be connected to an electrostatically-deflected CRO to provide multiple storage of waveforms, which can be erased at will. It features two stable d-c ampli



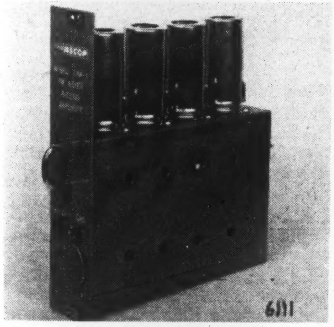
6103

fiers that provide better than full-screen deflection of direct display storage tube; hinged camera mount for easy photographing.—*Advanced Electronics Mfg Corp., 2025 Pontius Ave., Los Angeles 25, Calif.*

For more information circle **280** on inquiry card.

KEYER AMPLIFIER

New "Model DKA-1 PW Keyer-Record Amplifier" combines a standard 900 sample-per-second pulse width



eyer and a record amplifier in a ingle unit which is interchangeable ith the FM or PWM/AM record trips in Record Electronics Assembly f any "Ampex 800 Series" airborne ecorders. Unit meets all essential inctional requirements of MIL-E-400; plugs directly into "Ampex 00."—*Applied Science Corp., of rinceton, P. O. Box 44, Princeton, N. J.*

For more information circle **281** on inquiry card.

POWER SUPPLIES

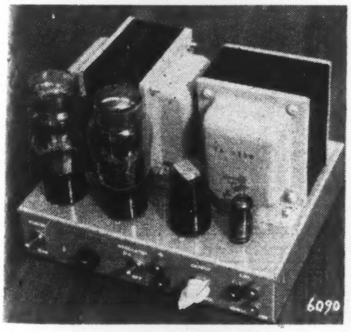
D-C POWER SUPPLY

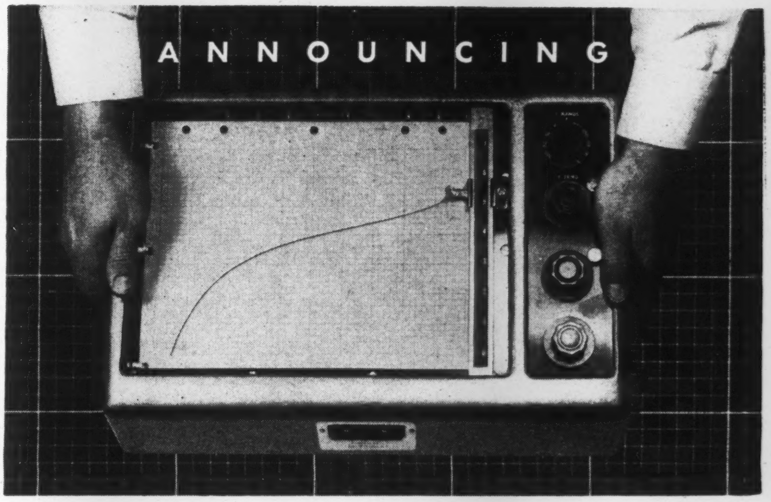
New "KS-2903" provides continuously-variable direct voltage from 1 to 13, with current of 15 amp, from 115-vac single-phase 50-60-cps input (230-v-input units available). Ripple is less than 1.5%.—*Kell-Strom Tool Co., Inc., Wethersfield, Conn.*

For more information circle **282** on inquiry card.

REGULATED POWER SUPPLY

New electronically-regulated power supply provides controlled voltage continuously variable between 250 and 400 v; also 6.3 at 4 amps unregulated. Either positive or negative may be grounded. Maximum continuous cur-

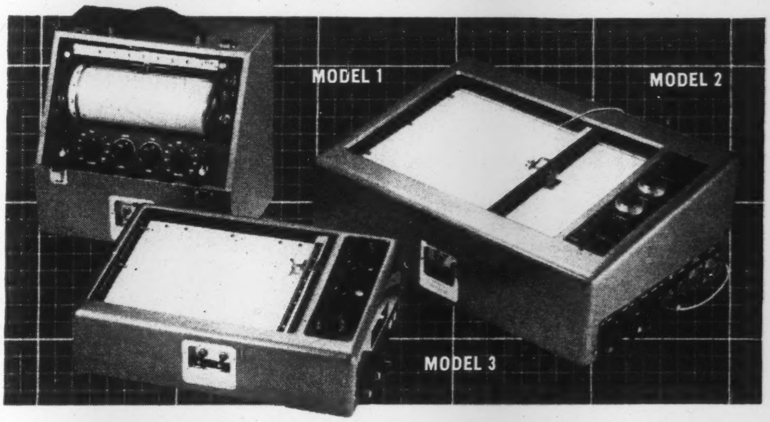




THE NEW MODEL 3
AUTOGRAF
trade mark

The Model 3 Autograf X-Y Recorder incorporates the proven features of the Model 2 in a compact instrument, ideal for use with standard 8½" x 11" graph paper. Rugged, accurate, fast, and stable, the Model 3 provides facilities for curve drawing and curve following with full visibility of the recording while in operation.

- Ranges: 5 mv up to 500 volts, full scale.
- Independent, isolated inputs, free of ground.
- Speeds: Up to ½ second. full scale.
- Resolution 0.1%; accuracy and resolution 0.25%.
- 200,000 ohms/volt input resistance.
- Zero set and one full scale length zero offset, both axes.
- Liquid ink or ball point pens.



The addition of the Model 3 to the Moseley Autograf line gives you three X-Y recorders to choose from:

MODEL 1	MODEL 2	MODEL 3
Drum type 8½" x 11" paper X-Y Recorder-Curve Follower	Flat-bed 11" x 16½" paper X-Y Recorder-Curve Follower-Point Plotter	Desk Type 8½" x 11" paper X-Y Recorder-Curve Follower

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Understanding Promotes Acceptance—Crow Electri-Craft has come up with a sensible and inexpensive solution to this problem. It's the new "visual experiment" kit—Electronic, Tubes, Circuits and Devices (Model 53).

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Easy to Understand—An illustrated 400-page manual shows how to build each assembly, discusses the theory involved and its practical application. No mathematical formulas . . . directions are so clear that the kits can even be used for self-instruction at home.

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Vincennes,
Indiana

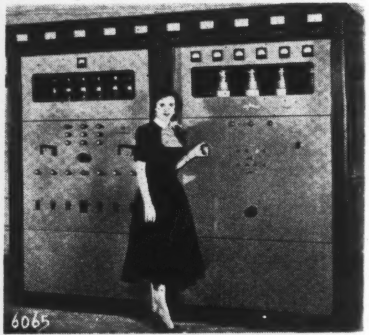
For more information circle **103** on inquiry card.

rent: 100 ma at 400 v, 225 ma at 25 v, between these points max current varies as a straight line. Ripple less than 0.001%. Regulation better than 0.1 v for line voltage change of ± 10%; better than 0.2 v for load current from 0 to 225 ma at 250 v.—*Thermador Electrical Mfg. Co., 200 S. Camfield Ave., Los Angeles 22 Calif.*

For more information circle **283** on inquiry card

SUPPLIES FOR ELECTRODYNAMIC SHAKERS

New power supplies expressly designed for electrodynamic shakers are said to permit vibration programming unattainable by other means: sweep-range sine-wave, complex wave, flight-simulation vibrations, etc. Photo shows a 30,000-watt model with frequency range of 5 to 3000 cps. Others from 250 to 400,000 watts.—*LM Electronics, Inc., 5017 Expositio Blvd., Los Angeles 16, Calif.*



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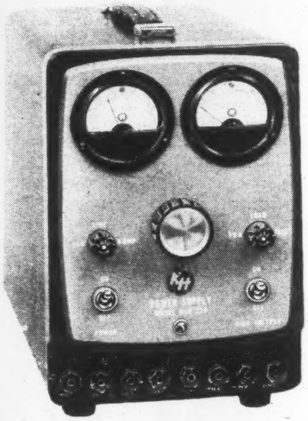
CLOSE-REGULATION SUPPLY

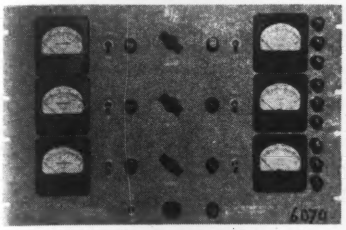
New "Model UHR-225" features no-load to full-load regulation of 0.002%; ripple less than 100 microvolt; 10-hr drift 500 ppm. In addition to dc output, two independent 6. vac outputs each rated at 5 amps.—*Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass*



For more information circle **285** on inquiry card

THREE-CHANNEL SUPPLY

New tubeless laboratory power source for use in transistor circuit development provides three independent "floating" output voltages, continuously adjustable from 0 to 50 v t 0-10 ma, with less than 1 mv of ipple, and 0.5% absolute regulation t 50 v. Higher current models are available, up to 1 amp.—*NJE Corp., 45 Carnegie Ave., Kenilworth, N. J.*

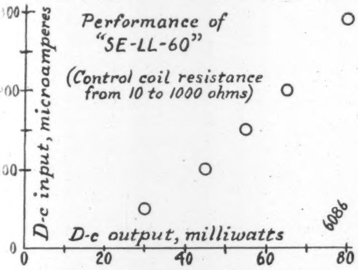


r more information circle **286** on inquiry card.

AMPLIFIERS

MAGNETIC AMPLIFIER

New "Type SE-LL-60" low-level magnetic amplifier, for output of thermocouples, photocells, strain gages, etc., features extremely low drift and exceptional high gain in a miniature size.—*Stator Electric Corp., 46-25 58th St., Woodside 77, N. Y.*



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AMPLIFIER FOR SCINTILLATION AND PROPORTIONAL COUNTERS

New amplifier to be used with maker's new scintillation and proportional counters, incorporates a regulated power supply, linear pulse amplifier, amplitude discriminator and three high speed binary counters. Provision is made for the addition of a pulse height analyzer.—*North American Philips Co., Inc., Mount Vernon, N. Y.*

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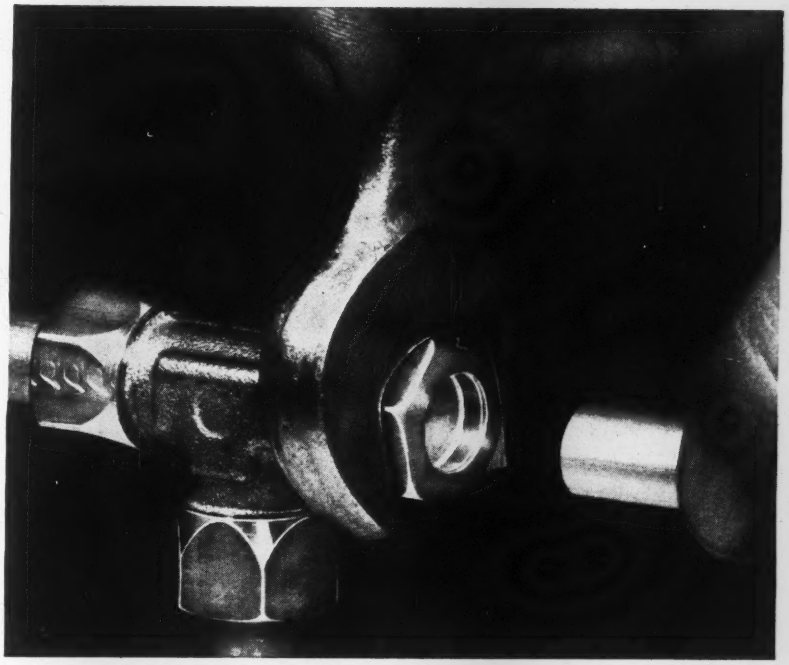
10-Mc WIDEBAND AMPLIFIER

New "Model 720" is a feedback-abilized wideband amplifier designed r use in amplifying fast pulses to a igh output level. Bandwidth is from elow 2,000 cps to 10 Mc; output tages deliver up to 50-v (pos.) pulses nto a 1500-ohm load or 10-v into a 00-ohm load. Input polarity switch llows either positive or negative in-



Simply push, then tighten! Anyone can quickly install all-new, *lightweight Intru-lok* tube fittings . . . the proven Parker 3-piece flareless design. Just insert the tube, then tighten the nut with a regular wrench . . . for a leakproof, vibration-proof joint. Made of brass for copper or nylon tubing. Send for complete details in Catalog 4324.

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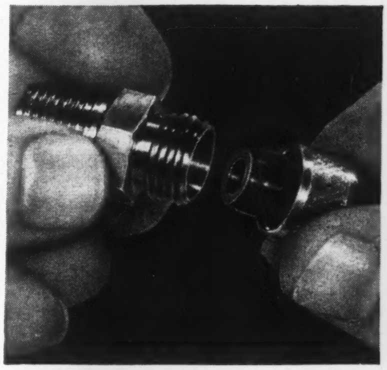

For soft plastic tubing you use knurled nut and expander insert with new *Intru-lok* body. Joints can be disconnected and reassembled. Complete details in Catalog 4324. Send for it.

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Hydraulic and fluid
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The United States Radium Corporation is experienced in marking by ALL methods, not just one. This enables us to recommend a marking best adapted to the type of part. These methods comprise photographic reproduction, screening, an improved offset process, etching, engraving, and lithography.

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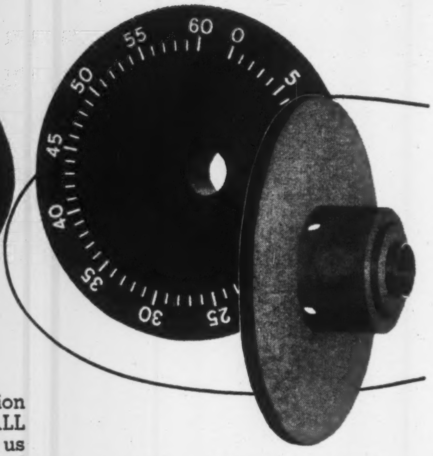

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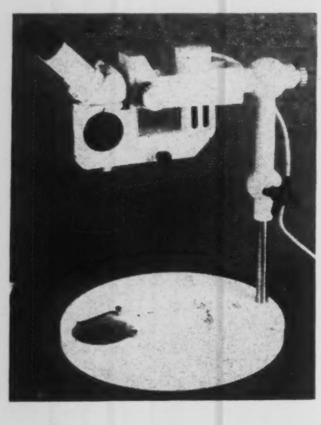


put pulses to appear as positive ou put pulses; 5-to-50-v fast pulse-height discriminator makes unit particularly useful for high-speed scintillatio counting.—*Electrical and Physical I strument Corp.*, 42-19 27 St., *Long I land City* 1, *N. Y.*

For more information circle **289** on inquiry car

ELECTRICAL COMPONENTS

MINIATURE p-n-p TRANSISTO

New "2N138" *p-n-p* fused junctio germanium transistor, for push-pu class B audio output applications, i available only in pairs matched fo optimum output and minimum distor tion. (In a typical class B applicatio using a 4.25-v supply, average powe output is about 50 mw with a powe gain of 30 db). Small physical dimen sions: identical to those of "2N13 Series" miniature transistors.—*Raytheon Mfg. Co.*, 55 *Chapel St., Newton* 58, *Mass.*

For more information circle **290** on inquiry car

H-F TRANSISTORS

New "760" series of diffused *p-n-p* junction transistors is designed fo high-frequency operation as RF and IF amplifiers in broadcast receivers, and as switches for high-speed computer application. "760, 761 and 762," with respective alpha cut-off frequencies of 5, 10 and 20 Mc, are encapsulated in plastic and hermetically sealed in a can.—*General Transistor Corp., Jamaica, N. Y.*

For more information circle **291** on inquiry card

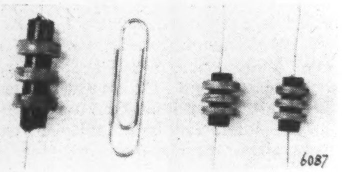
MEDIUM-POWER TRANSISTORS

New "2N 85, 86 and 87" transistors are designed for high-power dissipation with linear operation over a wide collector current range; are hermetically sealed under vacuum. Efficient thermal connections provide great power dissipation at elevated temperatures (up to 750 milliwatts dissipation at 25°C). Units are intended for Class A or B output or driving stages.—*Transistron Electronic Corp., Melrose* 76, *Mass.*

For more information circle **292** on inquiry card

MICRO-MINIATURE CHOKES

New "Mini-Choke" ferrite cored chokes are available from stock in



values of 500 uh, 1 mh, 2.5 mh and 5 mh.—*Superex Electronics Corp., 4 Radford Place, Yonkers, N. Y.*

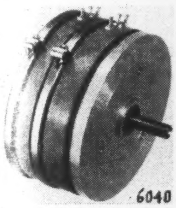
For more information circle **293** on inquiry card.

PRECISION VDR

New "Type 747-E" 2.1"-OD voltage-dividing resistor provides resistance range of 50 to 70,000 ohms, standard linearity of 0.15%. Innovation: special clamp band provides an unrestricted tapping area allowing up to 19 taps and presents a simplified means of phasing units in a ganged assembly without disassembling units. Low noise level and high resolution are said to make units particularly desirable for computer assemblies, calibration controls, servomechanisms, etc.—*Fairchild Controls Corp., Robbins Lane, Syosset, L. I., N. Y.*

For more information circle **294** on inquiry card.

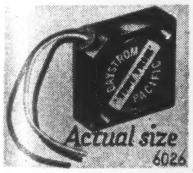
PRECISION VDR



New "Type 748-E" 3⅛" OD voltage-dividing resistor, resistance range 80 to 150,000 ohms, features standard linearity tolerance of 0.10% (on special order 0.05% can be obtained on higher resolution windings). Unrestricted tapping area allows up to 33 taps. Gangable up to 6 cup units on a single shaft.—*Fairchild Controls Corp., Robbins Lane, Syosset, L.I., N. Y.*

For more information circle **295** on inquiry card.

TRIMMING VDR

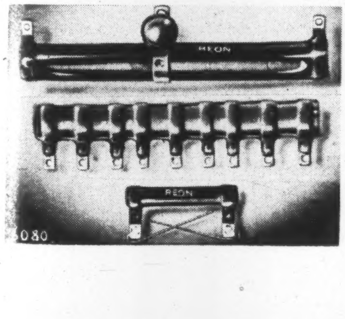


New "Model 300-00 Tiny Trim" is said to be "the smallest wire-wound precision potentiometer on the market . . . For system miniaturization where high accuracy must be maintained throughout broad environmental parameters."—*Daystrom Pacific Div., 3030 Nebraska Ave., Santa Monica, Calif.*

For more information circle **296** on inquiry card.

POWER RESISTORS

New power wire wound resistors, for continuous operation under ex-



NOW YOU CAN SPECIFY STANDARD R-S BUTTERFLY VALVES FOR FASTER DELIVERY

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When the delivery date is important, you can get faster service on standard R-S Butterfly Valves. Based on the results of previous experience, R-S Valves are now standardized. All components for those most commonly used, in sizes from 4" to 48", are carried in stock, ready for assembly.

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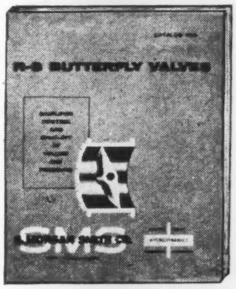
- compactness and light weight at less cost.



This new catalog will give you complete dimensions, specifications, layout drawings and materials for all R-S Butterfly Valves in the pressure ratings that have been standardized to date. As others are added, new sections will be published. To get a free copy and assure yourself of future sections, contact your SMS representative, or write to S. Morgan Smith Company, York, Pennsylvania.

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TYPE 930

Now, for the first time, the sustained accuracy of all-metal case construction is available in 10-turn and 3-turn potentiometers. These multi-turn units are capable of withstanding the severe environmental conditions required by military specifications and provide the user with high accuracy, reliability and long life.

ALL-METAL CASE CONSTRUCTION IN 10-TURN AND 3-TURN POTENTIOMETERS

The Types 930 and 933 are 1.812 in. diameter. In the Type 930 a linearity tolerance of ±0.05% is standard with linearity to ±0.025% for resistance of 2K ohms and greater. In the Type 933 the standard linearity tolerance is ±0.10%, with ±0.05% available in resistances of 10K ohms and above. Mechanical and electrical rotations are 3600° for Type 930, with standard tolerance of −0°, +4° or in special cases, −0°, +1°. For Type 933, rotations are 1080°, with standard tolerance of −0°, +4° and special tolerance of −0°, +1°. Furnished with all standard mountings. Flexibility of design makes it possible to supply many types of special mechanical and electrical features.

TYPE 933

SAMPLES AVAILABLE ON ORDER

Fairchild's complete line can help solve all your precision potentiometer problems. For more information write Fairchild Controls Corporation, Components Division, 225 Park Avenue, Hicksville, L. I., N. Y., Dept. 140-65B.

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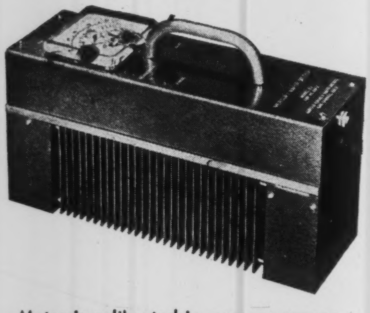
For more information circle 108 on inquiry card.

mercury vapor detector

tells instantly when a hazard exists in plant or lab atmospheres



Meter is calibrated in mercury concentrations for quick indication. The toxic limit is a full-scale reading on the high sensitivity scale of Model 23, illustrated. Wt.: 7 lbs.; size 13″ x 8½″ x 4½″. Three models for varying ranges.
Write for bibliography on the mercury vapor hazard, and literature on Kruger Mercury Vapor Meters.

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Don't Drop that Screw!

Hold it with an H.J.J. Screw-holding Driver

MADE IN A WIDE VARIETY OF SIZES

The H.J.J. COMPANY
268 Marlow Drive
OAKLAND 5, CALIF.

For more information circle 109 on inquiry card.

tremes of humidity, salt water, and severe atmospheric conditions, are available in three types: fixed, tapped, and adjustable; feature a built-in safety reserve; can be maintained at three times rated load without deterioration or damage.—*Reon Resistor Corp., 117 Stanley Ave., Yonkers, N. Y.*

For more information circle **297** on inquiry card.

SUBMINIATURE RESISTOR

New subminiature wire-wound resistor is supplied in either inductive or noninductive windings in lengths

Actual size
6077

from ¼″ to ¾″, in resistance values from 0.1 ohm through 0.5 megohm and in choice of standard tolerances from 1% to 0.1%. Temperature coefficient of resistance 20 ppm/°C.—*Precision Resistor Co., Inc., 107 U. S. Highway 22, Hillside 5, N. J.*

For more information circle **298** on inquiry card

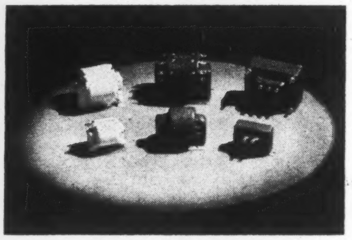
MYLAR CAPACITORS

New "Type KFM" subminiature flat mylar capacitors can readily be used with graphic circuits and automatic assembly processes. All sizes are supplied with two sets of parallel leads; are encapsulated in Kel-F to provide a moisture seal and stable operating characteristics over a wide temperature range. Standard sizes are rated at 150 and 250 vdcw at 125°C. For use at 85°C and below, these ratings are increased to 250 and 350 vdcw respectively.—*Sanders Associates, Inc., Nashua, N. H.*

For more information circle **299** on inquiry card

ENCAPSULATED TRANSFORMERS

Three new types of encapsulated transformers for military and industrial applications. Left, high-temp.;



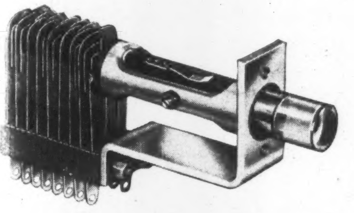
center, Class A; right, commercial/military. Various combinations of encapsulations enable designers to specify exact degree of encapsulation required without having to pay for unnecessary protective extremes.—*Specialty Transformer Dep't, G-E Fort Wayne, Ind.*

For more information circle **300** on inquiry card

ELECTROMECHANICAL COMPONENTS

KEY-TYPE RELAY

New "Type 100 Key" features an illuminuated plunger. Key is so designed that, regardless of stacking

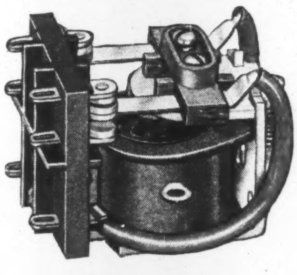


of spring leaves, spacing of multiple keys on panel can be uniform. Plunger is either locking or non-locking type utilizing a "Type T-2" telephone switchboard lamp of any standard voltage up to 60 v ac or dc. (Lamp can be operated on 120 v by providing a 2,000-ohm externally mounted resistor.) Plunger button Lucite is available in various colors, and can be engraved with a letter or number. —*Atocon Corp., Galion, Ohio.*

For more information circle **301** on inquiry card.

MIDGET POWER RELAY

New "Series 1200" ac or dc relay is rated up to 8 amps 115 v 60 cps non-inductive load. Contact combinations available up to 3p-dt. Standardized for applications such as automation, computers, etc.—*Guardian Electric Mfg. Co., Dept.* 1200, 1621 *W. Walnut St., Chicago* 12, *Ill.*

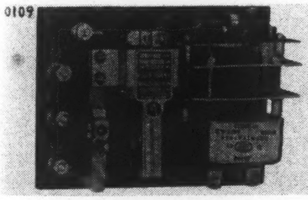


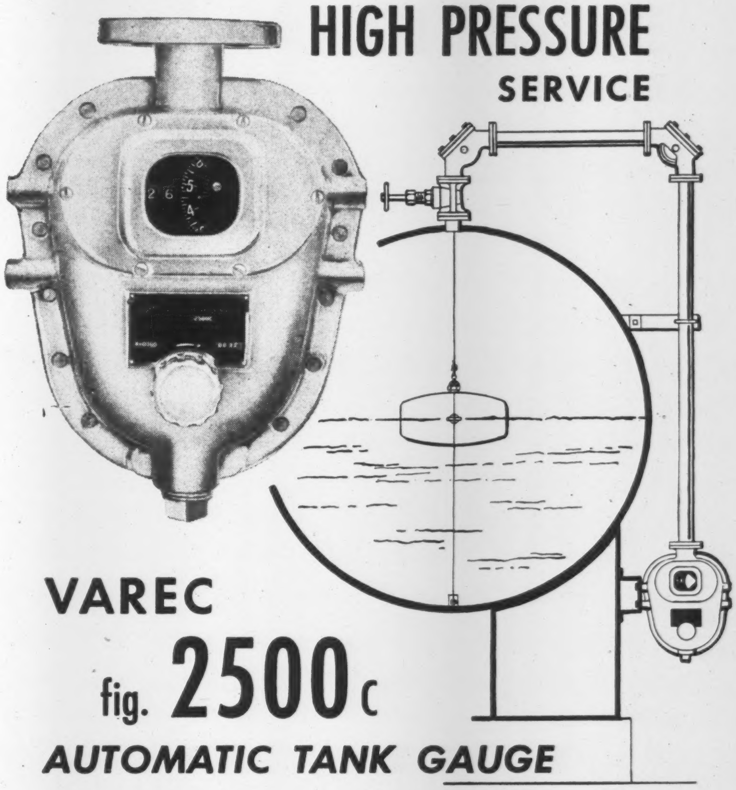
ACTUAL SIZE

For more information circle **302** on inquiry card.

CLOSE-DIFFERENTIAL RELAY

New low-cost "Bulletin 1054-207S Close Differential Relay" is designed to operate on small voltage and frequency variations; will drop-out at 80% to 93% of pick-up voltage with frequency held constant (smaller differentials can be obtained if re-





NOW- Available for HIGH PRESSURE SERVICE

VAREC fig. 2500c AUTOMATIC TANK GAUGE

Service in working pressures to 300 p.s.i.g. is offered by the new VAREC Figure 2500C Automatic Tank Gauge. It's a high pressure model of the successful VAREC Figure 2500 Series, equipped with the Neg'ator motor, which eliminates use of counterweight and simplifies installation. This series has been tested by 3 years of service in the Petroleum and Chemical fields, after 2 years of experimental and development work.

An important part of this new model is the magnetic drive, which requires no packing gland or mechanical seal on rotating shaft. The use of stainless steel ball bearing construction throughout provides a combination that reduces friction to a minimum.

Liquid level indication on a mechanical counter and dial for convenient, easy reading. Components are enclosed in a separate compartment to keep tank vapors from fogging dial. Operation checker is standard equipment.

Like the low pressure series Figure 2500 gauges, addition of remote gauger transmitter or control devices is a simple field installation. It is not necessary to remove the gauge head or disturb the original installation in any way.

Varec

VAPOR RECOVERY SYSTEMS COMPANY
2820 North Alameda Street
Compton 1, California
Cable address: VAREC COMPTON Calif. (U.S.A.) All Codes

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For more information circle **110** on inquiry card.

MINIATURIZED CONTROL

with New Types of Packless "DEMI"® VALVES

"Demi" Toggle Action is improved in the valve shown at the left. Positive indication of seat position is provided, with the same rugged, pinless toggle as in standard "Demi" Toggle Valves. Rating: 0-250 psig, —100 to +250°F. In globe, 3-way or manifold styles.

"Demi" Air Operated valves are typified by the center valve. For remote operation, with compact, interchangeable operation and body assemblies. A wide choice of materials is available. Body assembly rating: 0-1500 psig, —400 to +700°F. Operator rating: 160 psig, Max.

"Demi" Engineered valves for special applications, as shown on the right. Thousands of these valves are now protecting coaxial cables. An 18-8 stainless steel diaphragm seal assures years of leak-proof operation. Even liquid sodium is controlled by special "Demi" valves. Let us "miniaturize" your valve engineering problems.

Write for Complete Catalog and Name of our Representative in your area.

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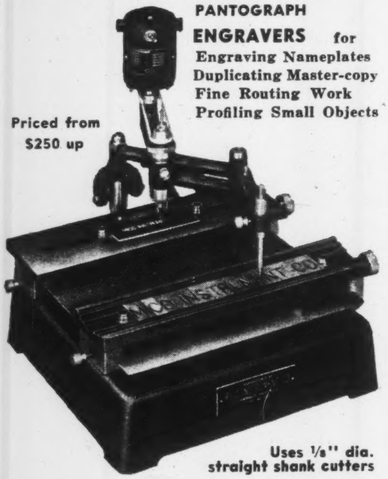

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MICO INSTRUMENT CO.
86 Trowbridge St., Cambridge 38, Mass.

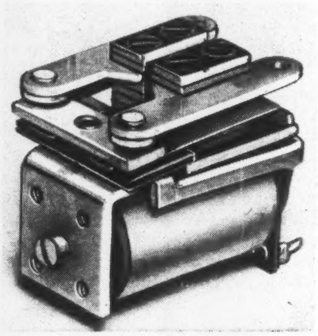
For more information circle **113** on inquiry card.

quired). With voltage constant, relay will pick-up and drop-out on variations of a fraction of a cycle.—*Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.*

For more information circle **303** on inquiry card

HEAVY-DUTY RELAY

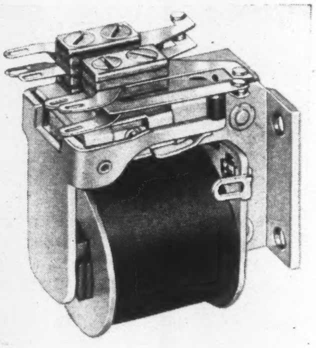
New "Class 11D" miniature relay has sp-st normally-open double-break contacts that can handle up to 20 amp non-inductive load. Minimum coil operating power is ½ watt.—*Magnecraft Electric Co., W. Grand Ave., Chicago 51, Ill.*



For more information circle **304** on inquiry card

COOL-RUNNING AC RELAY

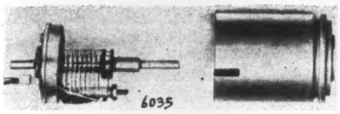
New "Type "R", said to offer "the advantages of telephone-type performance in an AC relay," is cool-operating, thus making it particularly suitable for use where hermetic sealing or dust covers are required. Available open, with dust covers, or hermetically sealed.—*Comar Electric Co., 3349 Addison St., Chicago 18, Ill.*



For more information circle **305** on inquiry card.

MINIATURE LOW-TORQUE SELECTOR SWITCH

New switch is available with several different brush and circuit combinations. Photo shows a selector unit with 10 input circuits and one output (break before make). Rotating element is a slip ring assembly with a series of commutator segments



interconnected to individual rings. Precision instrument bearings minimize torque. Extremely low contact resistance by use of gold alloy brushes for input and output.—*Electro Tec Corp., South Hackensack, N. J.*

or more information circle **306** on inquiry card.

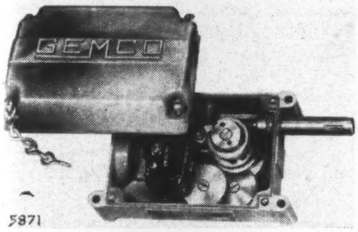
SWITCH AND RHEOSTAT COMBINATIONS

New "Series 25GS and 50GS" power rheostats incorporate a switch for multi-circuit applications; are basically aircraft power rheostats, "Series N-3155," modified to accommodate power switches of spst, spdt or dpst construction.—*Clarostat Mfg. Co., nc., Dover, N. H.*

r more information circle **307** on inquiry card.

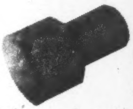
ROTARY LIMIT SWITCH

New "Model B" rotary limit switch, featuring ratios of 250:1, 500:1 or 000:1, has two Micro-switches, operated by independently adjustable cams, to provide upper and lower limits.—*Gemco Electric Co.,* 25681 *W. 8 Mile Rd., Detroit* 19, *Mich.*

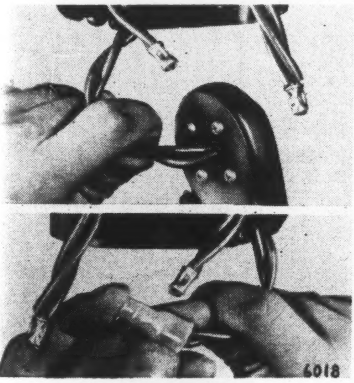


or more information circle **308** on inquiry card.

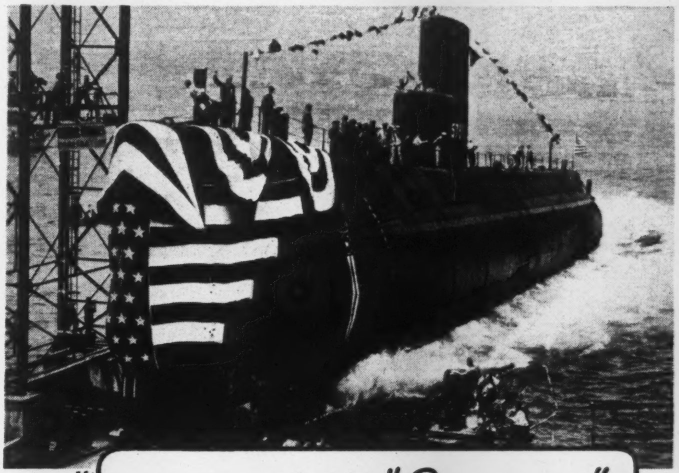
SPLICE-CAP INSULATOR



New "Nylon Splice Cap Insulator" features "snap-on-lock" design said to assure "factory perfect insulation of wire splices." Eliminates threading, wrapping, or twisting of insulator during installation and any possibility of its loosening in service even under extreme vibration. Trans-



The "Ceramo" thermocouples to be used to measure temperatures for evaluation of efficiency and safety of the "Seawolf's" atomic reactors have Stainless Steel sheaths and Chromel-Alumel thermocouple wires.*



T-E'S NEW "Ceramo" THERMOCOUPLES WILL BE USED TO CHECK REACTOR TEMPERATURES ON ATOMIC SUB "SEAWOLF."

Where the conditions are the toughest—where heat, corrosion and radiation have made it difficult to write a specification—you can depend on finding "Ceramo" thermocouples. The "Ceramo" sensing element of this new Thermo Electric thermocouple consists of a metal sheath, protecting two thermocouple wire conductors which are separated and firmly fixed in place by ceramic insulation.

Although this thermocouple is rugged enough to stand pressures of several thousand p.s.i. and temperatures to 1600° F., it may be bent to *any* configuration. "Ceramo" thermocouple extension wire is also available, in all standard thermocouple materials . . . comes in sizes from 1/16" to 1/4" diameter.

Get all the latest information on these new metal-clad, ceramic-insulated wires and thermocouples.
Write for Bulletin 31-300-F.

*Photo Courtesy Electric Boat Division of General Dynamics Corp. and U. S. Navy

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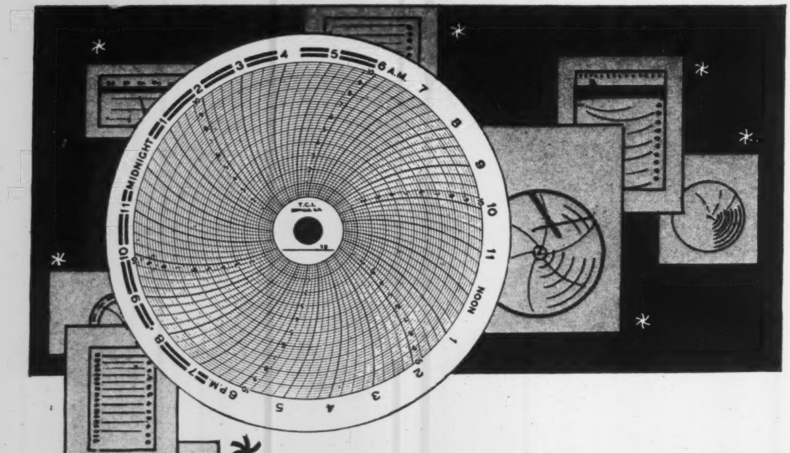

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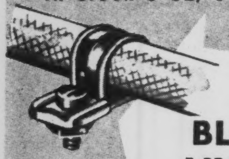

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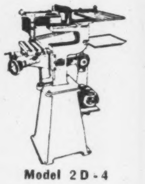

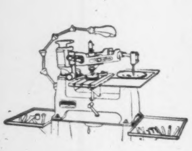

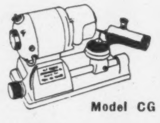

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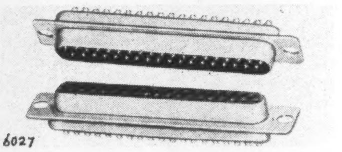
For more information circle **117** on inquiry card.

lucent Nylon body permits easy inspection of completed splice. Available in two sizes which splice norma circuit wiring from two #18's through three #8's or two #6's. Approved b UL and Canadian SA for buildin wire to 600 v and in fixtures to 100 v, up to 105°C.—*Buchanan Electrica Products Corp., Hillside, N. J.*

For more information circle **309** on inquiry car

MINIATURE CONNECTOR

New "Series CCC 20" is lightweigh miniature connector available in 3 contacts (15 and 25 contacts on special order). Shells are stainless steel insulated body is Orlon-filled dially phthalate (MIL-P 4389); pin contacts are gold-plated brass; socke contacts are gold-plated spring-temper phosphor-bronze.—*Electroni Sales Div., DeJur-Amsco Corp.,* 45-01 *Northern Blvd., Long Island City* 1 *N. Y.*

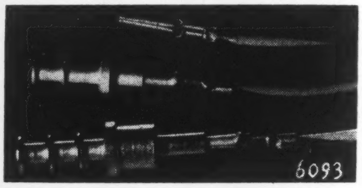


6027

For more information circle **310** on inquiry card

SOLDERLESS CONNECTIONS

New "2700 Series" tapered terminal and receptacle lugs permit quick connection of wiring without soldering.



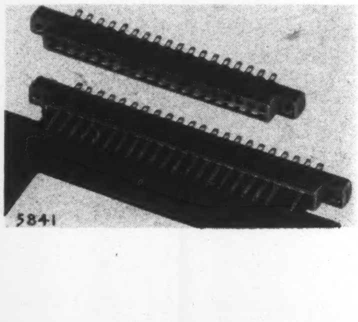
6093

Six standard sizes, single-end or double-end terminals, and feed-thru types, fit standard terminal board thicknesses from 1/32" through 3/16". Excellent current-carrying capacity; suitable for etched circuit and multiple stacking applications.—*U. S. Engineering Co., Inc.,* 521 *Commercial St., Glendale 3, Calif.*

For more information circle **311** on inquiry card.

PRINTED-CIRCUIT CONNECTORS

New "Bellows Type" are available in single- and double-row construction of 6, 10, 15, 18 or 22 contacts. Design



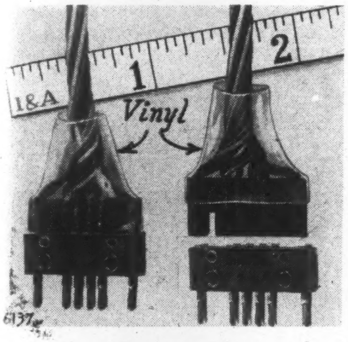
5841

is said to "provide longer contact life and smoother engagement." Connector accepts 0.054" to 0.071" variation of standard 1/16" copper-clad printed-circuit laminated card (receptacle to accomodate ⅛" board also available on special order). Choice of wiring styles and molding compounds.—*De-Jur-Amsco Corp., 45-01 Northern Blvd, Long Island City 1, N. Y.*

r more information circle **312** on inquiry card.

MALE PRINTED-CIRCUIT CONNECTOR

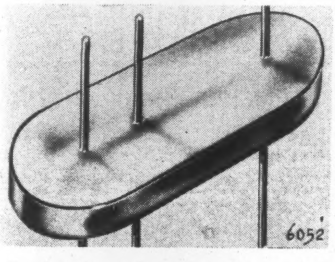
New male printed circuit connector shows five improvements over previous models: (1) higher insulation resistance and humidity performance; (2) sustained near-perfect contact; (3) virtually no damage to contact bond from careless application of wires to contacts; (4) wider extremity contacts provide sound cabling and relief of strain; (5) Vinyl insulating hood provides built-in mold for potting of connectors if user desires.—*Circon Component Co., 17544 Raymer St., Northridge, Calif.*



r more information circle **313** on inquiry card.

TRANSISTOR HOUSING BASES

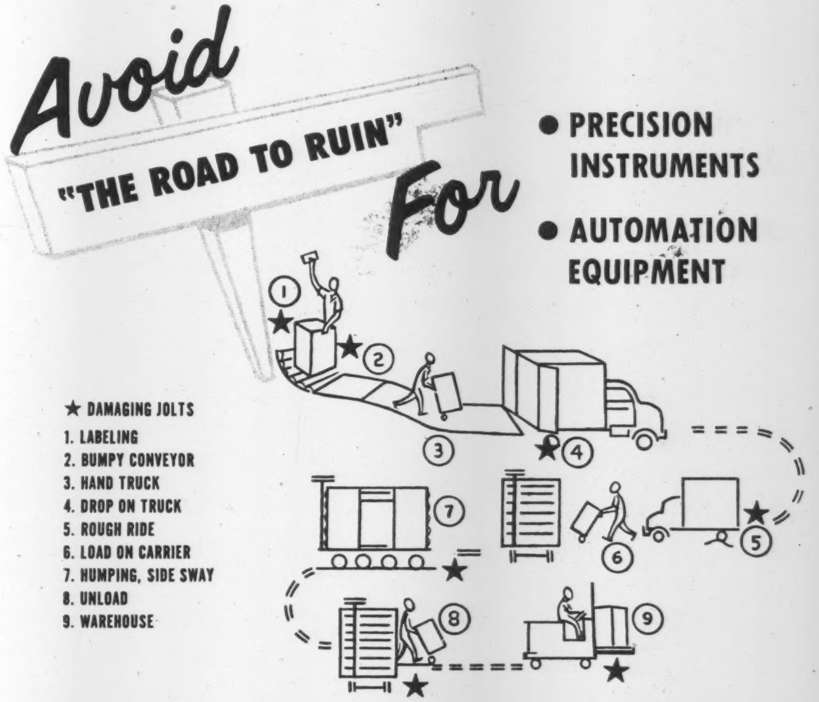
New "No. 1619 Transistor Base" features all-glass construction in its internally exposed area, preventing contamination of a transistor wafer when closure is made after mounting. —*Hermetic Seal Products Co., 33 outh Sixth Street, Newark 7, N. J.*



r more information circle **314** on inquiry card.

QUICK CONNECTORS

New jack and plug are suited for uick and tight patch work on panel oards. Jack "X2200" can be had in hank lengths for panels from 1/32"



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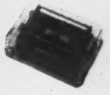
MODEL YC— "Yard Recorder" for registering longitudinal impact of freight car handling.

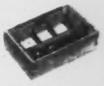
MODEL H—3-directional recorder for shipping with merchandise and drop testing. 28 day continuous operation.

MODEL R—3-directional recorder for freight cars. Records side sway, rough track, etc. 28 day operation.

MODEL SS—single directional recorder primarily for vibration checks and comparative riding quality analysis.



MODEL HXS— small 3-directional recorder tape advances with each impact. Ideal for package testing and for shipping with small merchandise.



MODEL HX— small 3-directional "ONE-Time" recorder (tape does not advance). Ideal for product and package testing.

THE IMPACT-O-GRAPH CORPORATION

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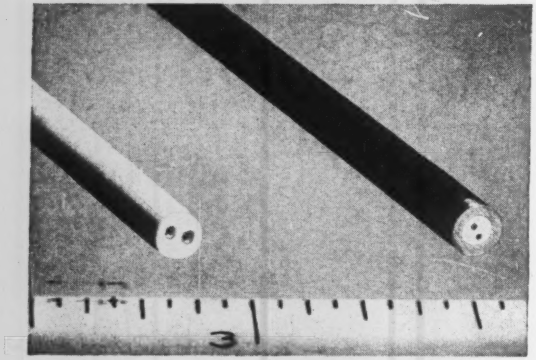

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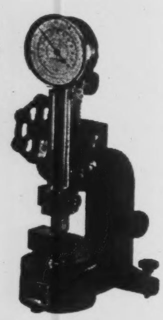

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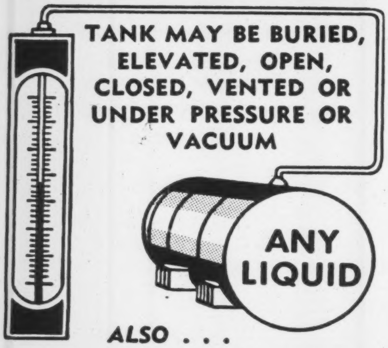

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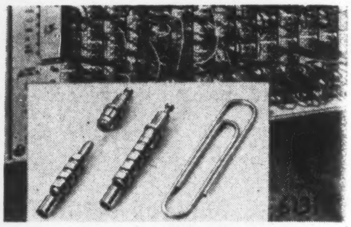
470 GETTY AVE., PATERSON, N. J.

For more information circle **121** on inquiry card.

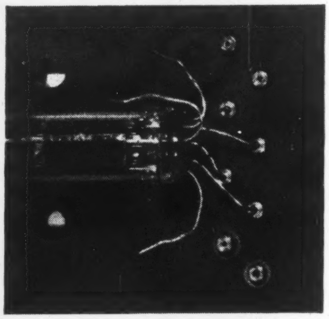


to 3/16"; is 0.210" high whe mounted; diam 5/32". Plug "X2201 will accept up to #20 wire which ca be soldered and then crimped throug insulation to prevent fraying.—*Cambridge Thermionic Corp., 445 Co cord Ave., Cambridge, Mass.*

For more information circle **315** on inquiry car

SPRING SOCKETS

New "Micro-Pin Socket" makes possible solderless connecting of diodes transistors, etc. Outer shell (abou



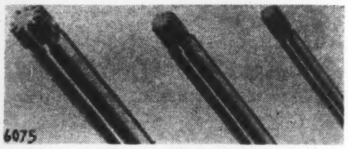
0.2" long and 0.08" diam) is press-fitted and dip-soldered into circuit board, making excellent electrical contact for leads. Available from stock to fit leads of 0.016" diam; soon be available for other sizes.—*Techron, Inc., 254 Friend St., Boston, Mass.*

For more information circle **316** on inquiry card.

MECHANICAL COMPONENTS

PRECISION PINION SHAFTS

New "Type F4" (available from stock) have been designed to run with all maker's other stock items. Pinions

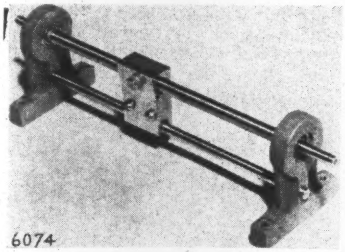


are available in 48, 64, 72 and 96 pitches with 20° pressure angles, 10 to 18 teeth; shafts are available in ⅛", 3/16" and ¼" dia, tolerance within 0.0001".—*PIC Design Corp., 160 Atlantic Ave., Lynbrook, L. I., N. Y.*

For more information circle **317** on inquiry card.

LEAD SCREW ASSEMBLY

New "Type X1" converts rotation of shaft into translation of a carriage which can mount a pen or indicator.



6074

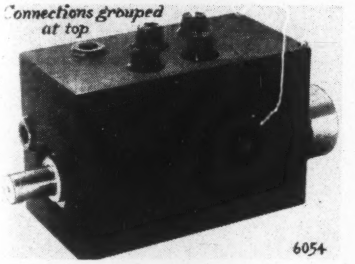
wo precision assemblies are avail-ble from stock: "X1-1" which has 050" of movement per and "X1-2" hich has 0.0356" (other leads avail-ble).—*PIC Design Corp.*, 160 *Atlan-c Ave., Lynbrook, L. I., N. Y.*

r more information circle **318** on inquiry card.

VALVES

SERVO CONTROL VALVE

New "Model CO-5," for use in fol-w-up positioning systems where echanical input signals are obtained



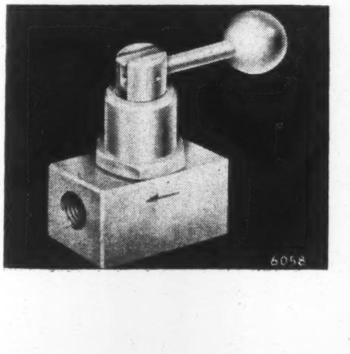
6054

from cams or linkages, features rectangular internal ports for linear flow output at constant valve pressure drop, precision "lap" characteristics for positional accuracy, hardened and lapped sleeve and spool construction, valve flow *vs* displacement characteristics easily modified to suit individual power and stability requirements.—*Hydraulic Controls Co.*, 87 *Terrace St., Roxbury* 20, *Mass.*

F r more information circle **319** on inquiry card.

TOGGLE-OPERATED SHUT-OFF VALVE

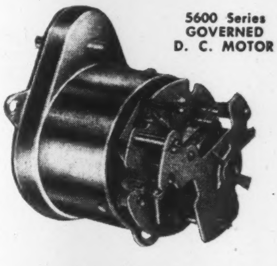
New toggle operated shut-off valve atures quick-acting operation when mediate dead-tight shut-off is re-



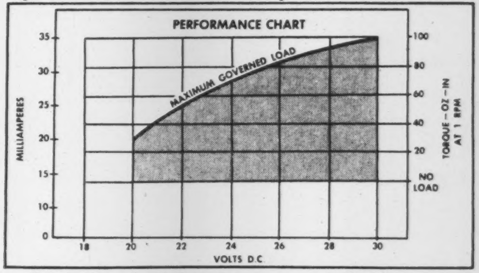
6058

they shall not pass!

A. W. HAYDON PRECISION GOVERNED 5600 SERIES MOTOR insures performance of America's perimeter defenses.



5600 Series GOVERNED D. C. MOTOR



SPECIFICATIONS
1. Voltage range nominal ± 20% at 68°F.
2. Ambient temp. range minus 65°F to plus 165°F.
3. Vibration 5-55 cycles per sec. with 10g max. accel.
4. Tolerance on escapement rate:
   (a) ± 0.1% under condition 1
   (b) ± 0.3% under condition 2
   (c) ± 0.5% under condition 3
5. Shock — per MIL-E-5272A, Proc. 1 (30g for 11ms)

Rated 30 oz.-in. full load torque at 1 RPM. Torque is limited by materials used in gear train to 20 oz.-in. intermittent or 5 oz.-in. continuous duty at 1 RPM. Special gear trains are available.
Output speeds from 900 RPM down to 1 revolution in 2 hours can be provided.

WHEN TIMING POSES A PROBLEM CONSULT . . . .

(General Catalog Sent on Request)

The A. W. HAYDON COMPANY
228 NORTH ELM STREET
WATERBURY 20, CONNECTICUT

Design and Manufacture of Electro-Mechanical Timing Devices

For more information circle **122** on inquiry card.

Clary printed digital recording

NOW WITH CLARY NUMERICAL DATA PRINTERS you have a *choice* of machines which convert your output to *printed digital recording.*

Now, to solve a wide variety of recording applications, choose Clary models capable of accepting either *serial*-type entry or *parallel* entry. The low cost and extreme flexibility of Clary automation equipment have already made it a prime factor in science and industry—including automatic printing of computers; analog-to-digital converters; scales; digital voltmeters; automatic production devices; electronic counters; inventory systems; temperature and pressure-recording systems; weather observations; laboratory instrumentation.

We also engineer and produce the versatile Clary Input Keyboard, Printing Timer, and other specialized counting and recording equipment. Call or write: Electronics Division, Dept. IA 16, Clary Corporation, San Gabriel, California.

Clary
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cash registers
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electronic equipment
automatic controls
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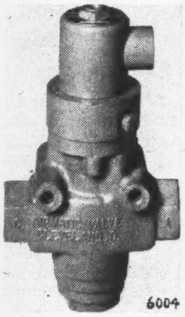
For more information circle **123** on inquiry card.

quired; is designed for liquid or gas up to 0-3000 psi. Stem crosses a throttling seat which insures gradual starting or stopping of flow, eliminating shock or water hammer.—*James-Pond-Clark, 2181 E. Foothill Blvd., Pasadena 8, Calif.*

For more information circle **320** on inquiry car

PILOT-OPERATED AIR VALVE


6004

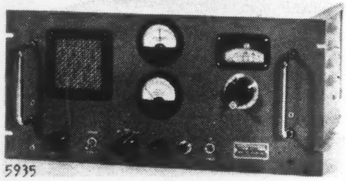
New "S-3 S ries" 3-way sol noid-pilot-ope ated air valve o fers positive bul ble-tight shut off; is suitable for a clutches, ai brakes, powe feeds, etc.; ope ates withou springs; is "fail safe." Operatin pressure from 3 to 150 psi.—*Ai matic Valve, Inc 7317 Associate Ave., Cleveland Ohio.*

For more information circle **321** on inquiry car

MISCELLANEOUS

SPECIAL-PURPOSE RECEIVER

New "1670 Series" special-purpos receivers retain all best features o old "167" line; principal improvemen consists in a complete redesign of I

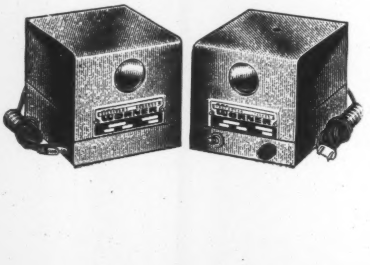

5935

amplifier strip; greater stability mechanically and electrically; sensitivity improved by use of better limiters front end redesigned mechanically output amplifier redesigned to provide better frequency response and substantially lower hum level.—*Nems Clarke, Inc., Jesup-Blair Drive, Silver Spring, Md.*

For more information circle **322** on inquiry car

BURGLAR ALARM

New "Two-Unit Worner Watchman" comprises (1) relay-and-photo cell unit and (2) light-source uni equipped with removable infrared fil



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For
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SENIOR COMPUTER ENGINEER

At least five years experience with analog computers with control applications. A degree in electrical engineering, or math and physics required. Activity is in the field of aircraft and missile power plant controls, including gas turbine, ram jet, and rocket types. Work will be with hydramechanical, pneumatic and electrical components. The fuel metering research facility includes an analog computer and jet engine simulators.

The salary of this position will be determined by your ability and experience.

Send detailed resumé listing education, engineering experience, and salary requirement to:

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John Unertl Optical Co.
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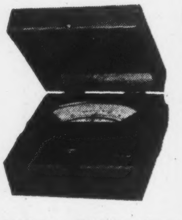
Pittsburgh 14, Penna.

For more information circle 124 on inquiry card.

TEST YOUR MAGNETIC CIRCUITS



RAWSON FLUXMETER
TYPE 504

The only portable fluxmeter available which returns rapidly to zero when a single button is depressed. Simple and fast in operation. Convenient and light in weight.

Not limited to a single type of measurement. Has universal application for laboratories or production. Measures strength of magnets and electromagnets, permeability and hysteresis loops for iron and steel, total flux lines in circuit, flux lines developed in air gap, etc.

Has a mechanical clamp to protect the pivots and jewels when in transit.

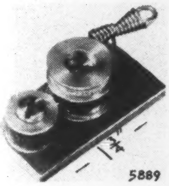
RAWSON ELECTRICAL INSTRUMENT COMPANY
112 POTTER STREET, CAMBRIDGE 42, MASS.

For more information circle 125 on inquiry card.

ter. System is designed for an invisible light beam with a range up to 35 ft; can be regulated for continuous alarm or for alarm to sound only while light beam is broken.—*Worner Electronic Devices, Box 226, Rankin, Ill.*

or more information circle **323** on inquiry card.

"B-MOTOR" MODEL



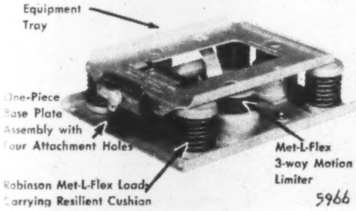
5889

New working model of "B-motor" form of "Neg'ator" constant-torque spring motor aids development of mechanisms; is smaller than "B-motor" model reviously introduced; is mounted on 1" x 1¾" plastic base; exerts a ominal 6-oz tension on output cable s it is extended through 36".—*Neg'ator Div., Hunter Spring Co., Lansdale, Penna.*

or more information circle **324** on inquiry card.

SHOCK AND VIBRATION PROTECTION MOUNTINGS

New all-metal mounting systems for protecting airborne electronic equipment against both shock and vibration are said to be "unique in carrying out the double function of providing the most effective high-frequency vibration protection without amplification of heavy *G* forces on vital components"; are available in four variations for any type of electronic equipment.—*Robinson Aviation, Inc., Teterboro, N. J.*

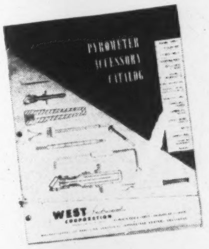

Equipment Tray
One-Piece Base Plate Assembly with Four Attachment Holes
Robinson Met-L-Flex Load Carrying Resilient Cushion
Met-L-Flex 3-way Motion Limiter

5966

For more information circle **325** on inquiry card.

PHOTOGRAMMETRIC PLOTTER

New "Balplex Plotter" produces maps from aerial photographs with contour intervals as small as 1 to 2 ft.



THERMOCOUPLES
for every industry

DATA BOOK
New 32-page file book

- ★ Handily lists all data (I.S.A.) and
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- ★ Lists all components, with prices and
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STANDARD AND SPECIAL

For furnaces, ovens, kilns, moulding machines, pipelines, freezers, etc.

For use with all standard types of temperature indicators, controllers, recorders.

We make thermocouples from matched and checked wires to insure constant millivolt output for accurate readings. Complete selection.

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For more information circle **126** on inquiry card.

ALINA KNURL CUTTERS

ALINA KNURL CUTTERS actually mill the pattern and produce chips in the process. Alina Knurl Cutters will cut your machining time approx. 30%. They will provide the solution to some of your most complex knurling problems.

DESIGNED TO
- knurl all machineable materials
- knurl thin-walled parts without internal support
- maintain fine diametral limits
- knurl diameters from 1/16" to 10 ft.

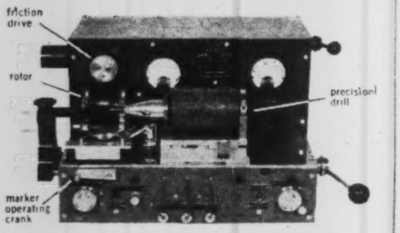
Models available for all types of machines.
For detailed information and prices, write to

ALINA CORPORATION • 401 Broadway, New York 13, N. Y.

For more information circle **127** on inquiry card.

NOW

measure and correct
rotor unbalance to
better than .00001 in-oz.



- A dynamic balancer to put laboratory precision on the production line.
- Locates, measures, and corrects unbalance of high speed rotors without removal from fixture.
- Automatic location and marking of point of unbalance—visual indication of plane and degree of unbalance.
- Complete with automatic metered drill on a single portable chassis 12" x 15" x 21".

Now you can locate, measure, and correct the unbalance of any high speed rotor (shaft length and dia. up to 4") without removal from the mount. This new Decker Dynamic Balancer quickly brings the rotor up to balancing speed, and automatically holds it within 2 rpm of that speed. Electric sparking automatically locates the point of unbalance on the rotor periphery, with the plane and amount of unbalance visually indicated. The high precision drill on the chassis can then be used to remove as little as .000001 ounce of material. Rotors too large for mounting on the chassis can be balanced through the use of remote pick-ups. The entire operation is simple enough for unskilled personnel.

Complete information on the new Dynamic Balancer is in Instrument Data Sheet 211, available upon request to Technical Literature Section,

DECKER AVIATION CORPORATION
1361 Frankford Ave., Philadelphia 25, Pa.

decker

For more information circle **128** on inquiry card.

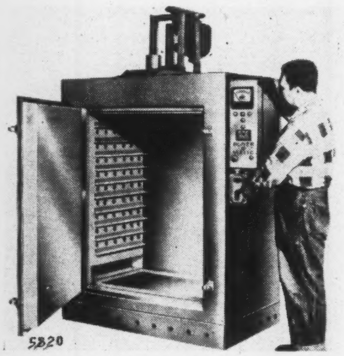
NEW INSTRUMENTS

When placed in plotter, reduced transparencies (diapositives) made from aerial photographs produce a three-dimensional view of the ground as might be seen by a giant with eyes hundreds of feet apart. Accurate maps with scales as large as 1" to 50 ft can be produced. Maps can be made from photos taken from heights as low as 1,000 ft or as high as 35,000 ft.—*Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.*

For more information circle **326** on inquiry card.

CONTROLLED OVENS

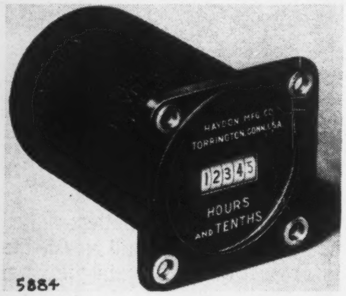
New models of maker's "Industrial Batch Ovens" feature new "Power-O-Matic" control system which automatically proportions wattage in direct relation to operating temperature and work load, resulting in straight line control throughout entire oven range. Temperature range 100°F to 600°F. Five sizes, from 16 to 96 cu ft.—*Blue M Electric Co., 138th & Chatham St., Blue Island Illinois.*



For more information circle **327** on inquiry card.

ELAPSED TIME INDICATOR FOR AIRCRAFT

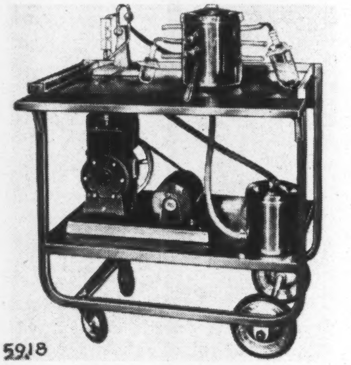
New running time meter is said to make available for the first time a direct-reading counter with a synchronous motor drive in a 1½" diam. case. Two models: one indicating hours in 1/10-hour steps to 9,999.9; the other minutes in 1/10-minute graduations to 9,999.9. Both operate on 115-v 400-cps; are hermetic sealed. —*Haydon Mfg. Co., Inc., Torrington, Conn.*



For more information circle **328** on inquiry card.

FREEZE DRYER

New "VirTis Freeze-Mobile" has advantage that all elements necessary for freeze drying procedures are compactly mounted on an easy-to-clear polished stainless-steel cart.—*E Machlett & Son, 220 E. 23d St., New York 36, N. Y.*



For more information circle **329** on inquiry card

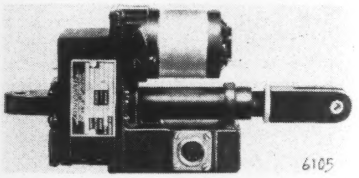
THERMOSTAT BIMETAL

New "ASC-3" thermostat bimetal for use in electrical appliances, finds applications also in aircraft, nuclear and meteorological equipment. It is a versatile material with a wide range of linear deflections between −100°F and 800°F (maximum sensitivity 200 to 600° F). It combines high deflection rate with a high torque rate, and is claimed by maker to be "most economical thermostat metal in its range." It is produced in thicknesses down to 0.001", widths down to 0.093", in coils or lengths cut to order. Spiral and helical coils, flat blades, U-shapes, cantilever strips and other elements are available.—*American Silver Co., 36-70 Prince St., Flushing 54, N. Y.*

For more information circle **330** on inquiry card

POWER UNIT

New "R-580 AC or DC Linear Actuator" weighs 2 lb; is rated at 650 lb max. operating load, 2000 lb ultimate static load; conforms to MIL-A-8064.—*Airborne Accessories Corp., Hillside 5, N. J.*



For more information circle **331** on inquiry card

CHARGER-VOLTAGE CONTROL

New "Type SE-VC60" all-magnetic control unit is a universal adapter for any type of battery chargers to provide accurate (1.5%) cut-off when voltage at battery has reached rated

Lapp introduces the "MICROFLO" PULSAFEEDER

A CONTROLLED-VOLUME PUMP FOR PRECISION PUMPING AT MICRO-FLOW RATES

NO LEAKAGE!
NO STUFFING BOX!
LAPP PULSAFEEDER
MODEL
SERIAL
LAPP INSULATOR CO. INC. LEROY N.Y.

Now, a controlled-volume proportioning pump for laboratory application, pilot plants, and industrial production, where requirements are for pumping of precise volumes at micro-flow rates without risk of leakage or contamination of fluid being pumped. The "Microflo" Pulsafeeder combines the best features of both piston and diaphragm pumps by using a piston for constant volume measuring purposes and a diaphragm to seal the product pumped against leakage or contamination. All liquid handling parts have been selected for their resistance to corrosion. Maximum pumping capacity is 2150 ML. per hour, maximum discharge pressure 1000 psig. Pumping rate of the "Microflo" Pulsafeeder can be manually adjusted while the pump is idle or operating, or if desired, complete operation can be governed by automatic controls.

Lapp

WRITE
for Bulletin 500 which contains complete information and specifications on the new "Microflo" Pulsafeeder. Lapp Insulator Co., Inc., Process Equipment Division, 513 Wilson St., LeRoy, N. Y.

For more information circle **129** on inquiry card.

NOW...
Noise Free
A.C. Power!

NEW CURTISS-WRIGHT
DISTORTION ELIMINATING
VOLTAGE REGULATOR

- Reduces typical power line distortion to less than 0.3%
- Furnishes 1.4 KVA of distortion-free power
- Electronically regulates 115 V output to ±1%
- Recovery time less than 1/50 cycle
- Provides additional 4 KVA of ±1% electromechanically regulated power
- Electromechanical time constant only 0.6 seconds
- Electromechanical regulator, unlike usual magnetic voltage stabilizer, introduces no distortion or phase shift

Here at last is the ideal solution to the disturbing problem of harmonics and low frequency noise appearing in 115 V., 60 cps power sources. In one compact package, every laboratory can now obtain *both*

1) distortion-free, regulated power when needed, and simultaneously

2) a large supply of electromechanically regulated power for applications where normal line distortion is tolerable.

In addition to its general laboratory utility, this instrument is ideally suited for preventing instability and inaccuracy in a.c. computer system nulling operations. Many other applications. 230 V. model also available. Immediate delivery. $1,689 f.o.b. Carlstadt, N. J. Write for details.

Component & Instrument Department

ELECTRONICS DIVISION
CURTISS-WRIGHT
CORPORATION • CARLSTADT, N. J.

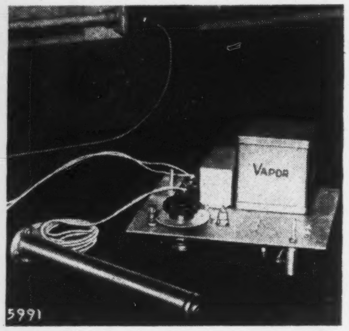
For more information circle 130 on inquiry card.

value. Selector switches allow presetting the cut-off from 2 to 40 v corresponding to 1 to 20 batteries in series. Units with charging currents up to 50 amps are available; special units can be supplied with voltage cut-off from 2 to 120 v. Size 12"x10"x8".—*Stator Electric Corp., 46-25 58th St., Woodside 77, N. Y.*

For more information circle **332** on inquiry card.

REFRIGERATOR-CAR CONTROL

New "Vapor Magnetic Amplifier Temperature Control" for railroad refrigerator cars has a temperature setting adjustable from —10°F to 70°F; is designed to control different types of mechanical cooling and heating systems now used by railroads.—*Vapor Heating Corp., Dept. PR, 80 East Jackson, Chicago 4, Ill.*



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For more information circle **333** on inquiry card.

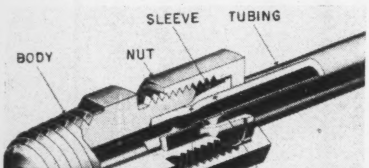
ENCAPSULATING RESIN

New "ADCeal" is an epoxide-polyamide compound which can be varied in curing and mixing cycles according to individual mechanical and electrical requirements; is virtually "shock-proof"; meets commercial and military requirements for thermal and mechanical shock.—*Audio Development Co., 2833 Thirteenth Avenue South, Minneapolis, Minn.*

For more information circle **334** on inquiry card.

SELF-ALIGNING FITTING

New "Selfalign" tube fitting can be installed without disassembling: Tubing is simply inserted in fitting until it bottoms and nut is tightened; dual sealing assures leakproof connections. Complete line includes union, union tee, union elbow, male and female connectors, male and female elbows, male tees for pipe on run and pipe on branch. Sizes ⅛" to ½".—*The Weatherhead Co., 128 W. Washington, Fort Wayne, Ind.*



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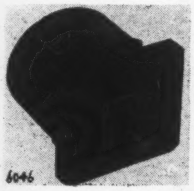
For more information circle **335** on inquiry card.

ACCELERATION PICKUP


6046

New Model GLO" is adaptation of "GLH" guided missile acceleration pickup to make it suited for operation in modern high-speed aircraft; is available in ranges from ±0 *G* to ±5 *G* or up to ±30 *G* with reduced damping.—*Genisco, Inc., 22 Federal Ave., Los Angeles 64, Cali*

For more information circle **336** on inquiry card.

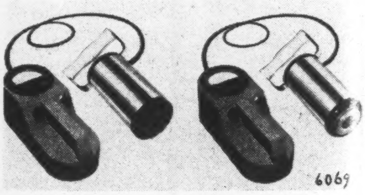
LINE VOLTAGE REGULATORS

New "Stablvolt" magnetic ac line voltage regulators hold output voltage within 0.25 v rms for line voltage variations from 100 to 130 v, line frequency variations from 57 to 6 cps and load variations from 0.3 to kva. Output voltage is continuously adjustable between 110 and 120 v rms. Units make precise power sources for measurement, control, computing, etc. No fragile elements, no parts to burn out or wear out. Among other features: operation practically failure-free, overload protection, wide input range, fast response and quiet performance.—*Magnetic Research Corp., 200-202 Center St., El Segundo, Calif.*

For more information circle **337** on inquiry card.

MOISTURE-CONTENT METERS

Two new models permit sensitive moisture indication in a variety of substances heretofore not measurable by quick electronic means. Each operates on a unique principle of high-frequency power absorption, permitting measurements to both higher and lower moisture ranges than instruments using conventional principles. "Model K2" (left) has spring-loaded button electrodes for measuring irregular or curved surfaces; "Model V2G" (right) has a large electrode for use on individual thicknesses or thin stacks, has a penetration of ⅛".—*Moisture Register Co., P. O. Box 910, Alhambra, Calif.*


6069

For more information circle **338** on inquiry card.

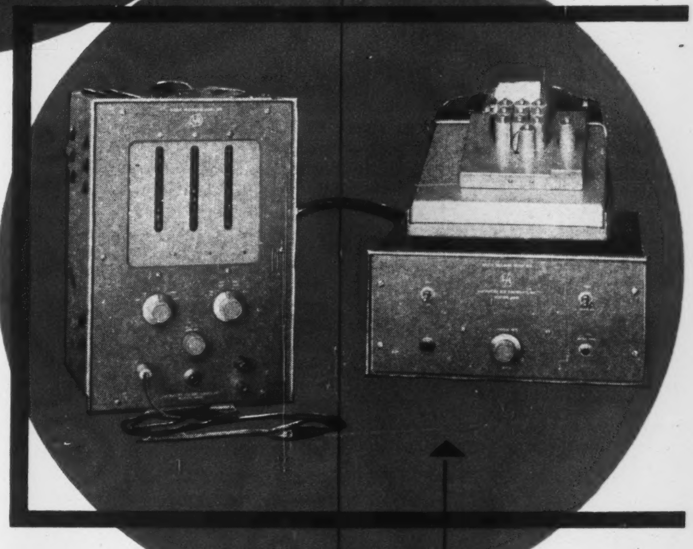
NOW ...continuous records of voltage changes

WITH THE NEW MODEL 504 DIGITAL RECORDER WHEN USED WITH THE MODEL 503 DIGITAL MULTITESTER

Here for the first time is a way to monitor voltages — either a-c or d-c — up to 1 reading per second and at the same time to obtain a printed record of the reading. The LFE Digital Recorder, latest addition to the LFE instrument line, expands the usefulness of other LFE apparatus such as the 503 Digital Recorder, shown here, or the 501 Time-Rate Indicator.

You can easily think of many ways in which an automatic printing device would be very useful as a read-out and printer for a volt-ohmmeter or frequency meter. Here are some suggestions:

- MONITORING OF LINE VOLTAGE CHANGES
- ANALOG TO DIGITAL CONVERSION
- AUTOMATIC RESISTOR TESTING
- AUTOMATIC RECORDING OF OUTPUT FREQUENCY
- AUTOMATIC READINGS FOR RAPIDLY CHANGING PHENOMENA
- LONG-TERM STABILITY CHECKS
- RECORDING OF TRANSIENTS
- KEEPING PERMANENT PRINTED RECORDS



Digital Recorder in use with Digital Multitester

Write for detailed specifications. Engineering representatives in principal cities.

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For export sales contact ANDREW S. SZUCS, INC.
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For more information circle **131** on inquiry card.

INSTRUMENTS and AUTOMATION Briefs

For this literature
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SAMA's Role In Industry

SAMA can offer you—the scientific instrument maker—a vital help in the operations of your particular company.

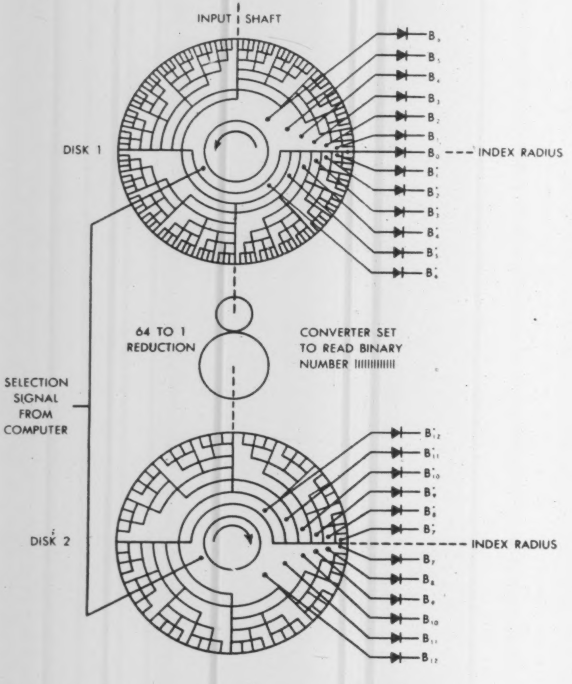
Typical of the many benefits SAMA members enjoy are the following:

The SAMA letter, trade reports, statistical surveys, studies and other valuable aids in your business operation. The six basic Sections of SAMA (are listed) as (1) Industrial Instrument, (2) Laboratory Apparatus, (3) Laboratory Equipment, (4) Nautical Aeronautical and Military Instruments, (5) Optical Products, and (6) Recorder-Controllers. (*From new 20-page booklet "You . . . and the Instrument Industry," Scientific Apparatus Makers Association, 20 North Wacker Dr., Chicago 6, Ill.*)

For this literature circle **401** on inquiry card.

Shaft-Position-To-Digital Converters

Designed for a variety of digital codes, these compact converters transfer data from shaft to code discs where non-ambiguous double brush pick-offs direct it to a scan network. Models cover seven to 19 digits, but by adding discs the range can be extended indefinitely. . . . Librascope analog-digital converter is available in Binary Coded Decimal, Binary or Gray Codes. Other modifications can be made to answer specific customer needs. In serial reading, the least significant digit is read first, synchronized with the computer clock pulse. Additional digital information is available when required.


INPUT SHAFT
DISK 1
INDEX RADIUS
64 TO 1 REDUCTION
CONVERTER SET TO READ BINARY NUMBER IIIIIIIIIII
SELECTION SIGNAL FROM COMPUTER
DISK 2
INDEX RADIUS

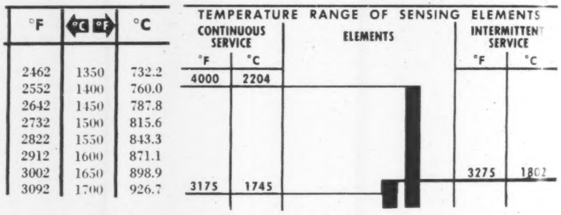
Ambiguity is eliminated by two brush pick-offs reading each track except the least significant. Brushes can be read serially or in parallel using a scan matrix or relays or transistors, and the circuit is readily time-shared. . . .

Current-carrying capacity is 2 ma per pick-off brush. Shaft speed for max. continuous input is 2 revolutions per second. Operating frequency is determined by computer characteristics. (*From new 6-page pamphlet "Analog-Digital Converter," Librascope, Inc.,* 808 *Western Avenue, Glendale, California.*

For this literature circle **402** on inquiry card.

Temperature Conversion Table

This two-color chart not only converts degrees Fahrenheit to Centigrade (or vice versa) from minus 400 to plus 4000, but also shows the temperature ranges of various sensing elements—thermocouples, resistance bulbs and radiation heads. Maximum limits for both continuous and intemittent services are also shown. (*From new 8½" x 11" chart and table, Thermo Electric Co., Inc., Rochelle Park Post Office, Saddle Brook, N. J.*)



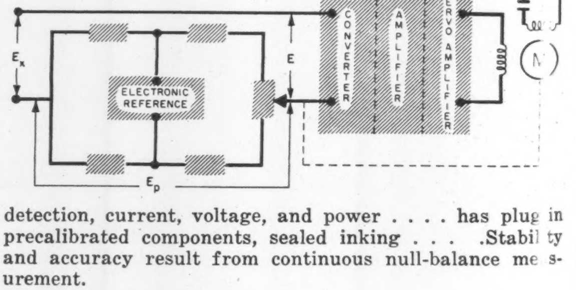
°F	◀°C °F▶	°C
2462	1350	732.2
2552	1400	760.0
2642	1450	787.8
2732	1500	815.6
2822	1550	843.3
2912	1600	871.1
3002	1650	898.9
3092	1700	926.7

TEMPERATURE RANGE OF SENSING ELEMENTS
CONTINUOUS SERVICE
°F
°C
ELEMENTS
INTERMITTENT SERVICE
°F
°C
4000
2204
3175
1745
3275
1802

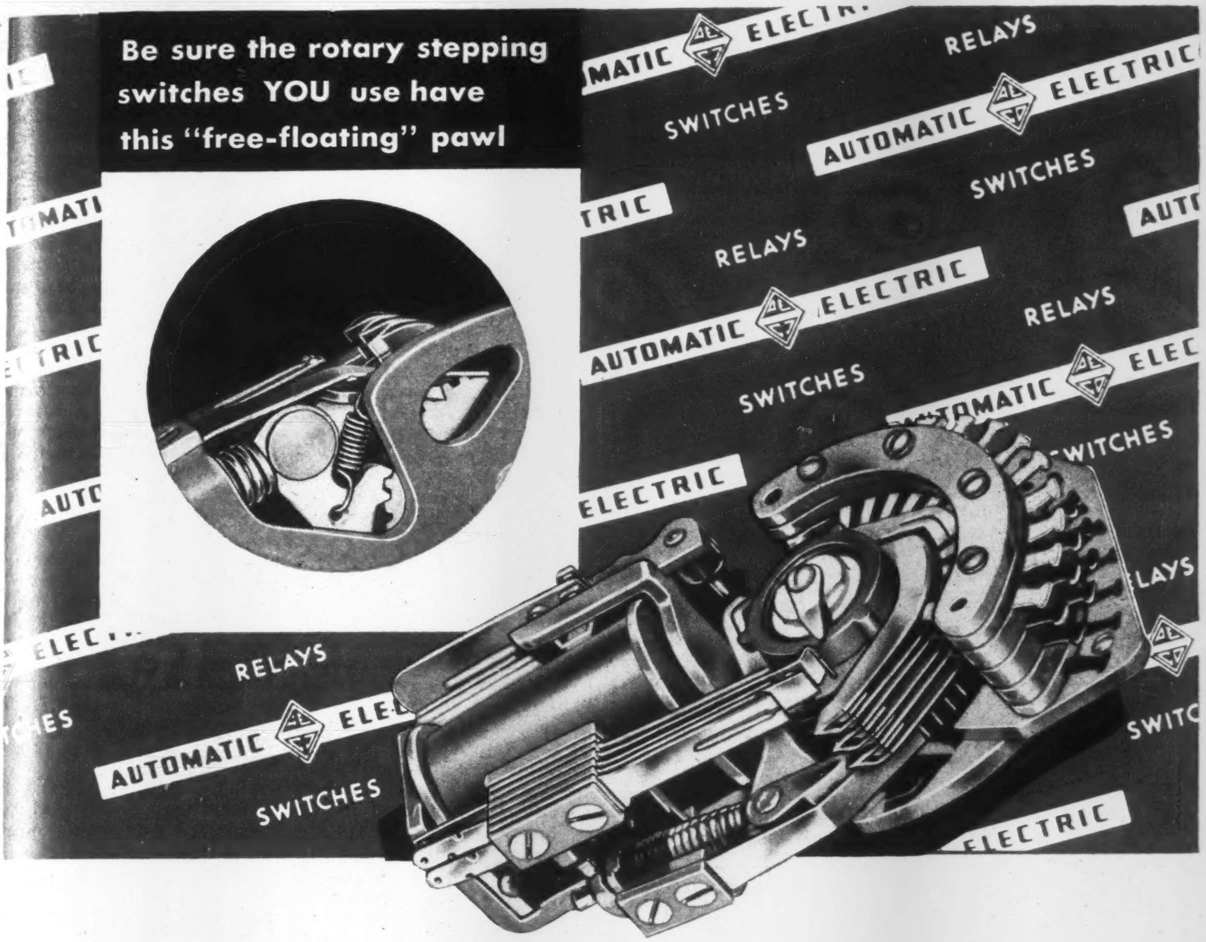
For this literature circle **403** on inquiry card.

Bailey DC± Recorder

This potentiometric receiver-recorder and controller is for continuous, independent measurement of one to four d-c signals in any combination . . . temperature, pH, force and pressure, flow and level, speed, radioactive isotope detection, current, voltage, and power . . . . has plug in precalibrated components, sealed inking . . . .Stability and accuracy result from continuous null-balance measurement.


DC-AC
A-C
CONVERTER
AMPLIFIER
SERVO AMPLIFIER
E_x
E
ELECTRONIC REFERENCE
E_p
A
M

Be sure the rotary stepping switches YOU use have this "free-floating" pawl



Automatic Electric Rotary Stepping Switches

insure bind-free operation

Look at the pawl in the small illustration above. Automatic Electric's Type 44 and 45 rotary stepping switches *can't* bind. Automatic Electric has eliminated the old-style pawl stop block that jammed the pawl and *caused* binding. Instead, Automatic Electric uses a unique "free-floating" pawl, and a set of stopping teeth on the end of the armature. These teeth engage the ratchet wheel smoothly, without jarring or jamming. They stop the wiper assembly positively, and position it exactly right on the bank contacts.

Automatic Electric offers many exclusive advantages over older type rotary stepping switches:

- Pawl breakage is eliminated
- Re-adjustment of armature stroke is never required
- There's no possibility of pawl binding, even at very low temperatures
- There's no possibility of double-stepping or overthrow

No wonder more and more design engineers are choosing Automatic Electric rotary stepping switches!

Plan now to use the Automatic Electric Type 44 or Type 45 rotary stepping switch in your products.

For complete information, write for Circular 1698. *Address* Automatic Electric Sales Corporation, 1033 West Van Buren Street (HAymarket 1-4300), Chicago 7, Ill. *In Canada:* Automatic Electric Sales (Canada) Ltd., Toronto. *Offices in principal cities.*

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BRIEFS—CONTINUED

Plug-in components for the recorder (include): (1) *Pneumatic receiver* receives 3-27 psig or 3-15 psig signals and drives a recording pen plus optional Integrator or *Pilotrol.* (2) *Air Control* converts electronic receiver measurements to pneumatic signals for control or transmission purposes. Where proportional and reset and rate control are required, a CLASS P transmits to a Bailey Computing Relay . . . (3) *A-C Electronic Receiver,* another member of the plug-in family of electronic receivers, amplifies a-c signals and drives a recording pen. It may be used in any combination with d-c receivers, so that a total of four units may be combined in one recorder case . . . . (4) *Integrator* is a precision totalizer of flow measurements from linear or non-linear flow transmitters. The Bailey Integrator is linked to an adjacent electronic or pneumatic receiver in the same recorder case. Accurate integration is achieved by use of an escapement mechanism. (*From new 12-page Product Specification E-12*[illegible]*, Bailey Meter Company,* 1050 *Ivanhoe Rd., Cleveland* [illegible]*, Ohio.*)

For this literature circle **404** on inquiry card.

Electromagnetic Pump

The a-c conduction-type electromagnetic pump operates on the basic principle of the "left-hand-rule." The liquid metal in the pumping section is a conductor of electricity. When a current is passed through it, perpendicular to a magnetic field, a force is produced on the liquid metal which results in motion within the pumping section. This motion is at right angles to the current and flux. . . . The flow rate is controlled from zero to maximum flow by an adjustable autotransformer.

Since the conduction type EM pump is symmetrical, the direction of flow of the liquid metal may be reversed by reversing the direction of the magnetic field with respect

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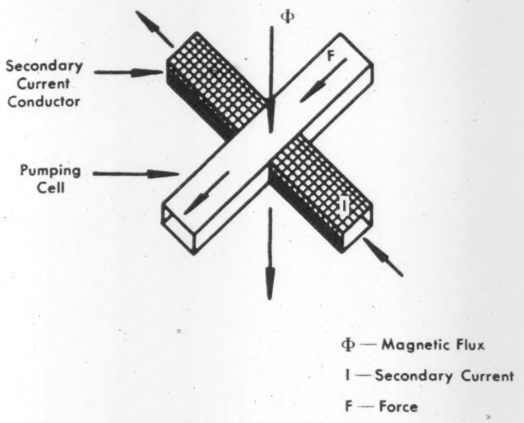

to the direction of the current through the pumping sections.

Conduction type EM pumps may be used to pump any liquid metal which will wet the pumping sections and which has a high conductivity. They are normally tested at 1000°F with sodium-potassium alloy (56% K, by weight). (*From new 4-page Bulletin EP-1, Callery Chemical Co., Callery, Pa.*)

For this literature circle **405** on inquiry card.

ELECOM 125 Compiler System

The ELECOM 125 Compiler System is an integrated set of service routines, the heart of which is the ELECODER I, a general purpose compiler routine. The ELECODER I routine compiles the program for a particular application in the following manner:

1. A list of the names of the subroutines which com-

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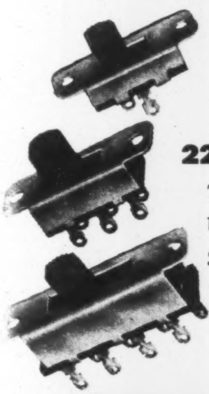

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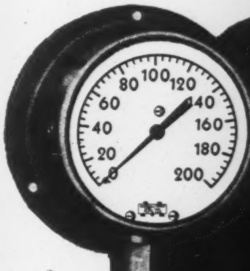

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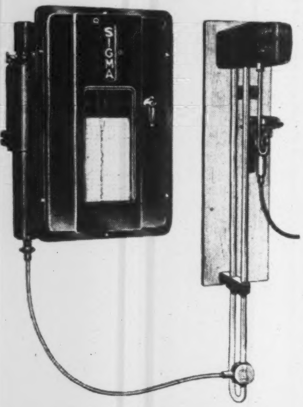

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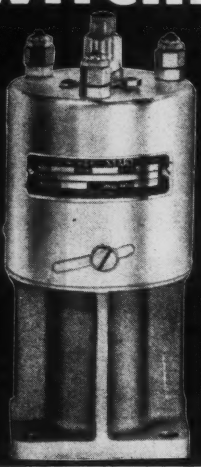

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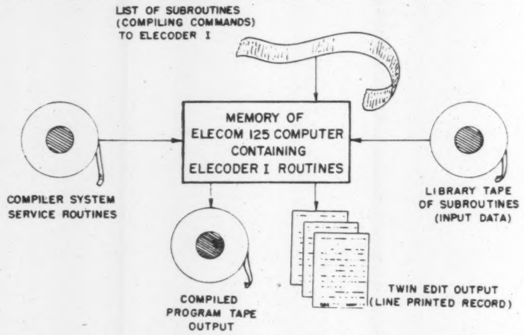
BRIEFS—CONTINUED


LIST OF SUBROUTINES (COMPILING COMMANDS) TO ELECODER I
MEMORY OF ELECOM 125 COMPUTER CONTAINING ELECODER I ROUTINES
COMPILER SYSTEM SERVICE ROUTINES
LIBRARY TAPE OF SUBROUTINES (INPUT DATA)
COMPILED PROGRAM TAPE OUTPUT
TWIN EDIT OUTPUT (LINE PRINTED RECORD)

prise the program for the application is punched o paper tape. A subroutine name is a four-digit numbe by which the compiler identifies a subroutine.

2. All subroutines pertinent to a particular applica tion are assembled on a single magnetic tape, called library tape.

3. Using the paper-tape list as compiling instruction and the magnetic library tape as input data, the ELE CODER I compiles the desired program and records it o magnetic tape together with the necessary reading in structions. This program tape is then used as the runnin tape for the program and has no further relation to th compiler. . . . In reality the system is a special purpos computer which performs automatically those operation of data processing which are more properly characterize as data handling of a large file stored on magentic tape *(From "Elecom Pulse", Vol. 1, No. 1, Electronic Com puter Division of Underwood Corporation,* 35-10 *36t Avenue, Long Island City* 6, *N. Y.*)

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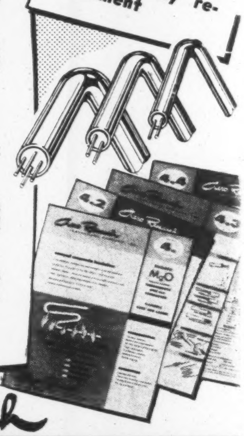

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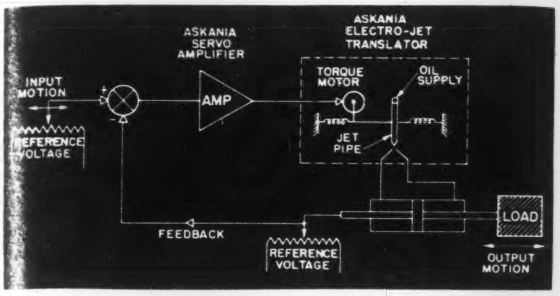
The Askania Electrojet permits remote control of valves, rods, etc., with great reliability and accuracy. The diagram shows an electro-hydraulic servo using the Askania Electrojet Translator. The output of this system may be increased to over 40 HP by the addition of standard Askania components, while the positional accuracy is maintained to better than 0.5%. *(From new 8-page folder, "For Atomic Energy Plants," Askania Regulator Company, 240 E. Ontario St., Chicago 11, Ill.)*



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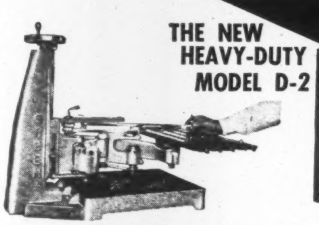
Recording Galvanometers

Moving-coil galvanometers are among the most versatile data-recording instruments in modern technology. They may be found thousands of feet below the earth in oil-well-drilling operations, or thousands of feet above the earth, recording the secrets of outer space. Between these two extremes, the galvanometer finds scores of uses in in-



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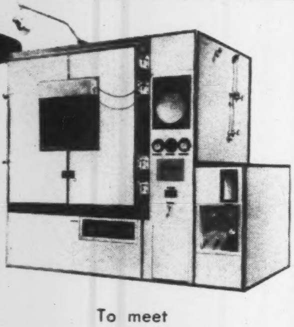

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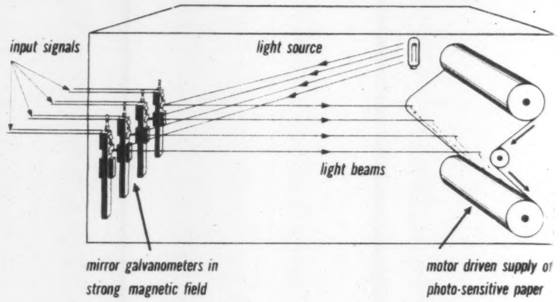
input signals
light source
light beams
mirror galvanometers in strong magnetic field
motor driven supply of photo-sensitive paper

dustry and research, measuring and recording stresse pressures, temperatures, accelerations, impacts, vibratio displacement, time, and velocity . . . Recording galvan meters are used mainly in two classes of recorders o oscillographs—direct writing and photographic.

Choice of a galvanometer involves the consideration o a number of factors. The value that must be placed o any one factor will depend on the application for whic the galvanometer is to be used: (1) sensitivity, (2 linearity, (3) frequency response, (4) figure of perform ance, (5) balance.

To assist in making comparisons between galvanome ters in which neither sensitivity nor undamped natura frequency is a common factor, a "yardstick" called "Figur of Performance" has been conceived. This is defined: F of P = KSf_n^2, where K is constant (10^{-4}), S is th galvanometer sensitivity (mm/μa at one meter), f_n is th undamped natural frequency (cps). (*From 16-page issu of "Recordings", Vol. 9, No. 4, Consolidated Engineerin Corp.*, 300 *North Sierra Madre Villa, Pasadena* 15, *Cali*

For this literature circle **408** on inquiry card.

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SPECIFICATIONS

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(other frequencies on request)
Distortion...............Less than 1%
Hum Level..............Approximately .05% of rated output
Output Power........3 watts into matched resistive load
Power Supply.........115 volts, 60 C.P.S., 40 watts
Dimensions............5-11/16 x 9 x 6⅛ inches

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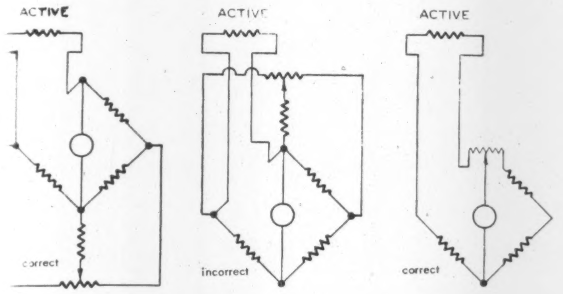
55 EAST 11th STREET • NEW YORK 3, N. Y.

For more information circle **147** on inquiry card.

Calibration of Wire Strain Transducer Systems

From time to time investigators have reported on their tudies and observations on wire strain gages and wire train transducers. In general these reports have not



resented a comprehensive analysis of the complete system, including the errors that may occur as a result of ie elapse of time after direct load calibration and as a sult of line resistance, modulus resistors and balancing etworks by the electrical equivalent method. ALINCO has und that in some cases, engineers have anticipated total stem errors of 0.25% but were confronted with errors 3 to 5% under actual conditions.

In order to assign an absolute value to the output of a rain gage transducer, it is necessary to provide some eans of calibration. There are two general calibration ethods in use: 1. Direct system calibration, i. e. direct pplication of a load to the transducer which provides a atio of load to output such as psi/mv or psi/ohm, etc. . .

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- **A thermosetting adhesive that cures at room temperature and needs no pressure. High electrical insulating properties.**
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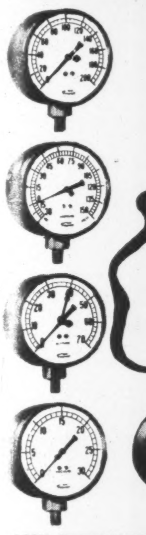

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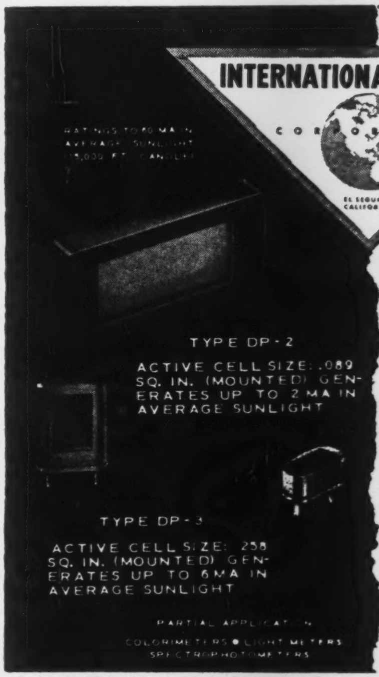
For more information circle **148** on inquiry card.



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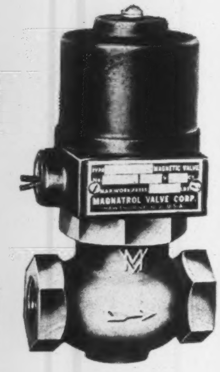
Costly
Flow Failures

Magnatrol
SOLENOID VALVES



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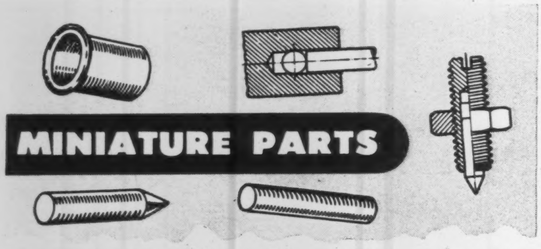

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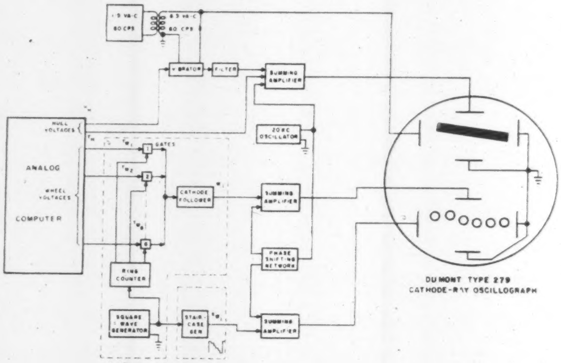
For more information circle **152** on inquiry card.

2. Electrical Calibration, i. e. any electrical configuration which would provide a transducer output equivalent to a known load. (*From new 22-page booklet. "A Report on Wire Strain Transducer System Calibration," Allegany Instrument Co., Inc., Cumberland, Md.*)

For this literature circle **409** on inquiry card.

Military Tank Simulator

At the Willow Run Research Center, University of Michigan, Ann Arbor, Michigan a cathode-ray oscillograph display system was developed to present a representation of the elevation view of a tank when it was subjected to various disturbing forces. . . . The hull of the tank was represented by a rectangle and the wheels by circles. It was possible to display the hull and road wheels simultaneously by using one beam of the Du Mont Type 5SP-dual-beam cathode-ray tube to display the hull and the other beam to display, on a time-shared basis,



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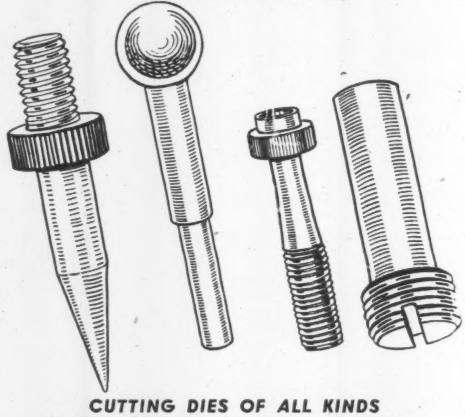

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each of the wheels. . . . By pictorial representation of the hull and the road wheels it was possible to note the behavior of eight simultaneously time-varying quantities in a manner exactly corresponding to their relationship in the real physical system. (*From "The Oscillographer," Vol. 15, No. 3, Allen B. Du Mont Laboratories, Inc., Instrument Division, 760 Bloomfield Avenue, Clifton, N. J.*)

For this literature circle **410** on inquiry card.

Chart of Ceramic Material

This chart lists ceramic materials, uch as Porous and 3 types Vitreous lumina, Steatite, Std. Electrical orcelain, Forsterite, Magnesia and luminum Silicate (Refractories), tupalith, Cordierite and Zircon. It abulates their respective values for ielectric Strength; Dielectric Conant, Power Factor, and Loss Factor t 1 megacyle; Water Absorption, hermal Stock Resistance, Thermal onductivity, Modulus of Rupture, lodulus of Electricity, Hardness Impact Resistance, Tensile Strength, ompression Strength, Linear Coeficient of Thermal Expansion, Denty, Specific Gravity, Gas Permeabily, Volume Resistivity, Softening emperature, and TE Value as well s General Characteristics and Typial Applications. (*From new 6-page older, Stupakoff Div., The Carborundum Co., Latrobe, Pa.*)

For this literature circle **411** on inquiry card.

iquid Scintillation Counting

In the past few years, an entirely ew technique has been developed for he determination of beta activity. his method, called liquid scintillation r liquid phosphor counting, has been emonstrated to be one of the most ensitive known for the detection of ery soft beta radiation in samples.

Liquid Phosphor or Liquid Scintilation Counting is based on the princile that if a beta radioactive sample be counted is dissolved directly in suitable scintillator, no energy is st by beta particles before reaching he counter or scintillator. Thus, much the energy of the particles is conerted into light by the scintillator, hich in turn may be easily detected y a photosensitive device.

Tritium, having approximately oneenth of the energy of carbon 14, an be easily counted with great acuracy and efficiency, thus making uch measurements a routine proceure for the first time.

(*From new 12-page booklet "Countng Soft Beta Emitters with Liquid hosphor Techniques," Technical Measurement Corp., 140 State St., New Haven 11, Conn.*)

For this literature circle **412** on inquiry card.

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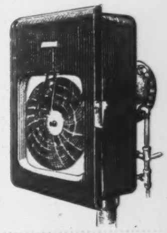
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INSTRUMENTS and AUTOMATION New Literature

AUTOMATION

Pneumatic Receivers. New 14-page bulletin describes maker's "Series 652" metagraphic indicating pneumatic receivers.—Bristol Co., Waterbury 20, Conn.

Circle **413** on inquiry card.

Process Control. New folder "Automation with Modern Instruments" pictures and describes maker's large line of automatic controlling, recording and telemetering instruments.—Bristol Co., Waterbury 20, Conn.

Circle **414** on inquiry card.

Automatic Packaging. New 4-page brochure describes maker's automatic packaging equipment.—Pak-Rapid, Inc., Elizabeth St., W. Conshohocken, Pa.

Circle **415** on inquiry card.

Walter Plant Instrumentation. New 8-page issue of "Chlorination Topics" (Vol. 9, No. 2) features article "Evansville, Indiana-Water Works Department."—Wallace & Tiernan, Inc., 25 Main St., Belleville 9, N. J.

Circle **416** on inquiry card.

Combustion Control. New 4-page issue of "Wheelco Comments" (Vol. 15, No. 5) features article on "New Firing Technique at Tillotson Refractories."—Barber-Colman Co., Rockford, Ill.

Circle **417** on inquiry card.

Control Transformers. New 32-page Catalog GED-2767 describes new large line of autotransformers, machine tool transformers, etc.—General Electric Co., Schenectady 5, N. Y.

Circle **418** on inquiry card.

Process Instrumentation. New 12-page Bulletin B-I-F 5 presents maker's large line of process instruments —flowmeters, level controllers, pressure and temperature instruments, feeders, process controllers, blenders, etc.—B-I-F Industries, Inc., 345 Harris Ave., Providence 1, R. I.

Circle **419** on inquiry card.

Control Systems Facilities Brochure. New 14-page Bulletin S-10 is facilities brochure outlining company's part in design, development, and application of control systems for processes, furnaces, etc.—Automatic Temperature Control Co., Inc., 5200 Pulaski Ave., Phila. 44, Pa.

Circle **420** on inquiry card.

Remote Control Telemeters. New 8-page Bulletin 230-H4A describes maker's "Chronoflo" telemeters for remote metering and control.—Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.

Circle **421** on inquiry card.

Business Telephone System. New 4-page Brochure 1769 describes uses of a business telephone system for controlling in-plant manufacturing operations.—Automatic Electric Sales Corp., 1033 W. Van Buren St., Chicago 7, Ill.

Circle **422** on inquiry card.

VALVES, ACTUATORS

Power Positioners. New Bulletin TP-MF1 contains specification sheets on performance and construction of maker's pneumatic power positioners. —Hagan Corp., Hagan Bldg., 323 Fourth Ave., Pittsburgh 30, Pa.

Circle **423** on inquiry card.

Solenoid Valve. New 2-page Bulletin V5006 describes maker's 1" 2-way solenoid valve for corrosive fluids and gases.—Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

Circle **424** on inquiry card.

Solenoid Valves. New 2-page Bulletin V5010 describes maker's midget-size 3-way solenoid valve.—Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

Circle **425** on inquiry card.

Solenoid Pilots. New 4-page descriptive Bulletin 1010 describes maker's solenoid pilots used with regulating valves.—Spence Engineering Co., Inc., Walden, N. Y.

Circle **426** on inquiry card.

Motorized Valves. New 4-page descriptive Brochure V100-5 illustrates maker's motorized valves with oil immersed reversing motors for controlling flow of steam and liquids.—Au-Temp-Co. Corp., 657 Broadway, New York 12, N. Y.

Circle **427** on inquiry card.

Valves. New 4-page Data Sheet Ua describes maker's line of slide gate-type segregating valves for pneumatic materials handling systems.—Allen-Sherman-Hoff Co., 259 E. Lancaster Ave., Wynnewood, Pa.

Circle **428** on inquiry card.

MOTORS, DRIVES

Motors. New 8-page Catalog 4271-6 describes maker's line of shaded-pole a-c motors for office machines, industrial instruments, etc.—Barber-Colman Co., Small Motors Div., 1200 Rock St., Rockford, Ill.

Circle **429** on inquiry card.

Motors, Tachometers. Five new Bulletins 540, 541, 542, and 543 describe maker's ac-dc tachometer generators, ac induction, hysteresis synchronous motors, etc.—PMI Instrument Motors, Stamford, Conn.

Circle **430** on inquiry card.

Speed Drives. New 4-page Catalog 1214 describes maker's "Series 100" electronic adjustable-speed drives.—Servo-Tek Products Co., Inc., 1086 Goffle Rd., Hawthorne, N. J.

Circle **431** on inquiry card.

Speed Controls. New 8-page issue of "Experimenter" (Vol. 30, No. 5) features article on "New Variac Speed Controls in 1 and 1½ hp Ratings."—General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Circle **432** on inquiry card.

Torque Control. New 8-page Catalog 955 presents maker's line of miniature magnetic clutches and brakes. —Dial Products Co., 9 Avenue E., Bayonne, N. J.

Circle **433** on inquiry card.

Motors, Gears. Two new 4-page booklets presents specifications on maker's gears and gearmotors.—Little Giant Products, Inc., Peoria, Ill.

Circle **434** on inquiry card.

TEMPERATURE

Rayotubes. New 24-page illustrated Catalog EN-S3 describes maker's line of "Series 8890 Rayotube" heat-radiation detectors for measuring temperatures to 5000 F and beyond.—Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Circle **435** on inquiry card.

TC Conversion Tables. New 16-page Booklet F 7255 "Standard Conversion Tables" presents thermocouple temperature-millivolt equivalents.—Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill.

Circle **436** on inquiry card.

Temperature Controller. New 2-page Specification Sheet 866 describes maker's "Ambi-Stat" remote-bulb temperature controllers.—Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia 44, Pa.

Circle **437** on inquiry card.

Pyrometers. New 8-page leaflet describes maker's panel type, portable and portable-surface pyrometers, thermometers, air velocity meters, etc.—Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, Ill.

Circle **433** on inquiry card.

TC Wire. New 12-page Bulletin 1701 presents conductor specifications and recommended insulations for various operating temperatures of standard thermocouple wires.—Revere Corp. of America, Wallingford, Conn.

Circle **439** on inquiry card.

Thermocouples. New 2- and 4-page Engineering Bulletins 1601, 1602, 1603 and 1604 cover design and selection of thermocouples for liquid, gas and surface temperature measurements.—Revere Corp. of America, Wallingford, Conn.

Circle **440** on inquiry card.

Infrared Detectors. New 2-page bulletin describes maker's "OptiTherm" infrared detectors for detecting infrared radiation and remote temperature measurements.—Barnes Engineering C ., 30 Commerce Rd., Stamford, C nn.

Circle **441** on inquiry card.

nfrared Radiation. New 2-page B lletin TDS-IRS pictures and de-s ibes maker's "Model IRS-1 Servoth rm" infrared radiation standards. —ervo Corp. of America, New Hyde P k, N. Y.

Circle **442** on inquiry card.

hermostat Chart. New equivalent cl rt compares properties of thermost t metals.—American Silver Co., I ., 36-07 Prince St., Flushing 54, N Y.

Circle **443** on inquiry card.

Ieat Transfer Apparatus. New 4-p e issue "SK Engineering News" (l. 7, No. 2) describes and illustr es maker's heat transfer apparatu , rotameters, spray nozzles, etc.—S utte & Koerting Co., Cornwells H ghts, Bucks County, Pa.

Circle **444** on inquiry card.

emperature, Pressure, Flow Measur ng. New 12-page Catalog 1 pictu es and describes maker's instrum nts for measurement of flow-rate, pr ssure, temperature, level, etc.—F cher & Porter Co., Hatboro, Pa.

Circle **445** on inquiry card.

PRESSURE

ressure Gages, Manometers. New 72-page catalog describes and illustrates maker's Magnehelic gages, inclined tube gages, pitot tubes, magneclips, "Flex-tube" manometer, hook gages, etc.—F. W. Dwyer Mfg. Co., P. O. Box 373, Michigan City, Ind.

Circle **446** on inquiry card.

lanometers. New 4-page illustrated brochure describes maker's inclined, U-tube and multiple-tube manometers; liquid level gages, orifice plates and flanges; etc.—Trimount Instrum nt Co., 3119 W. Lake St., Chicago 12 Ill.

Circle **447** on inquiry card.

ressure Transducers. Two new 2-p e bulletins describe maker's "Seri P100" pressure transducer and " ries P300" pressure-to-frequency t nsducer.—Datran Engineering C p., 3613 Aviation Blvd., Manhattan B ach, Calif.

Circle **448** on inquiry card.

P Transmitter. New 4-page Bull n MSP-130 pictures and describes m ker's "Delta P" pressure difference t ansmitter.—Hagan Corp., Pittsb rgh 30, Pa.

Circle **449** on inquiry card.

Pressure Gage. New 4-page Bullet n 364 presents specifications of mak-

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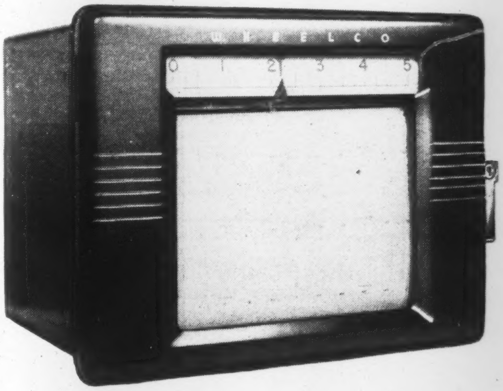

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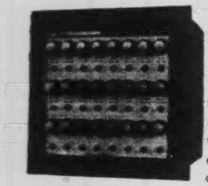

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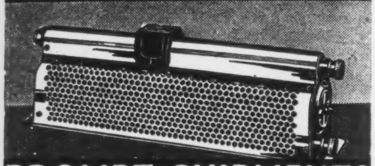

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NEW LITERATURE

er's "Acragage" pressure gage for industry, aircraft, etc.—Norden-Ketay Corp., Wiley St., Milford, Conn.

Circle **450** on inquiry card.

Pressure Ratio. New 4-page Bulletin 361 presents specifications of maker's pressure ratio indicating system for application on aircraft jet engines, etc.—Norden-Ketay Corp., 99 Park Ave., New York 16, N. Y.

Circle **451** on inquiry card.

Pressure Pickups. Twenty-two new 2-page engineering data sheet inserts for Wiancko catalog describe digital and telemetering equipment, pressure pickups, force pickups, acceleration pickups, etc.—Wiancko Engineering Co., 255 N. Halstead Ave., Pasadena 8, Calif.

Circle **452** on inquiry card.

Pressure Switches. New 4-page brochure describes maker's pressure switches; also gear boxes and precision gears.—Southwestern Industries, Inc., 5880 Centinela Ave., Los Angeles 45, Calif.

Circle **453** on inquiry card.

Pressure Indicator. New 2-page illustrated bulletin describes maker's "SLM" pressure indicator for engines.—Kistler Instrument Co., 15 Webster St., Tonawanda, N. Y.

Circle **454** on inquiry card.

FORCE, WEIGHT

Proving Rings. New 12-page Bulletin 116 describes maker's proving rings, calibrating systems and ring dynamometers.—Morehouse Machine Co., 233 W. Market St., York, Pa.

Circle **455** on inquiry card.

Checkweight Scale. New 2-page bulletin describes and illustrates maker's automatic checkweight scale for checkweighing of bags, drums, and cartons.—Weighing Components, Inc., 64 Fulmor Ave., Hatboro, Pa.

Circle **456** on inquiry card.

FLOW

Venturi Tubes. New 4-page Bulletin 100 describes maker's "Type TG" Venturi tubes and nozzles.—Simplex Valve and Meter Co., 7 E. Orange St., Lancaster, Pa.

Circle **457** on inquiry card.

Vibrating Feeder. New 4-page Brochure 55C describes maker's "Velofeeder" vibrating feeder for feeding to automatic scales, grinding mills, mixers, conveyors, etc.—Richardson Scale Co., Van Houton Ave., Clifton, N. J.

Circle **458** on inquiry card.

Purge Meters. New 8-page Bulletin 120 describes maker's line of "Brooks-Mite and Sho-Rate" purge meters for small flow indications.—Brooks Rotameter Co., Lansdale, Pa.

Circle **459** on inquiry card.

Air Meter. New 4-page Bulletin 55 pictures and describes maker's pushbutton "Anemotherm" air meter.—Anemostat Corp. of America, 10 East 39th St., New York 16, N. Y.

Circle **460** on inquiry card.

Plastic Pumps. New 4-page leaflet describes maker's "Flex-I-Liner" plastic pumps used in laboratory, pilot plant and production line for handling corrosive chemicals, etc.—Vanton Pump & Equipment Corp., 201 Sweetland Ave., Hillside, N. J.

Circle **461** on inquiry card.

Pumps. New 4-page Bulletin 855 describes maker's line of "Minus Delta P" controlled volume pumps for downhill liquid and gas metering.—Milton Roy Co., 1300 E. Mermaid Lane, Phila. 18, Pa.

Circle **462** on inquiry card.

COMPUTING, DATA REDUCTION

Decimal Keyboards. New 6-page leaflet describes maker's decimal keyboards for binary, binary coded decimal, or decimal inputs.—Librascope, Inc., 808 Western Ave., Glendale, Calif.

Circle **463** on inquiry card.

Digital Computer, Address Locator. New 6-page leaflet illustrates and describes maker's new "LGP 30" general-purpose computer for scientific and industrial laboratories. Includes an optimum address locator for finding optimum address locations while programming.—Librascope, Inc., 808 Western Ave., Glendale, Calif.

Circle **464** on inquiry card.

Computer. New 2-page illustrated bulletin describes maker's new "LGP 30" digital computer.—Librascope, Inc., 808 Western Ave., Glendale, Calif.

Circle **465** on inquiry card.

Power-Cost Computer. New 8-page issue of "Modern Precision" (Vol. 15, No. 2) features article on use of computer by Southern Company Power Pool; also on U. S. research reactor being demonstrated at Geneva, etc.—Leeds & Northrup Co., 4907 Stenton Ave., Philadelphia 44, Pa.

Circle **466** on inquiry card.

Digitizer Applications. New 8-page Booklet CR-179 "Digitizer Application Data" is a technical brochure on use of maker's Digitizer in various control and multiplexing systems.—Coleman Engineering Co., Inc., 6040 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle **467** on inquiry card.

Operational Equations. New 12-page Data File 120 describes use of operational equations for analog computer programming.—Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif.

Circle **468** on inquiry card.

NEW LITERATURE

Data Processing. New 8-page issue "Data from ElectroData" (No. 3) describes maker's "Datatron" integrated data-processing system.—ElectroData Corp., 460 Sierra Madre Villa, Pasadena, Calif.

Circle **469** on inquiry card.

Compiler System. New 12-page issue of "Elecom Pulse" (Vol. 1, No. 1) features article on "The Elecom 125 Compiler System."—Electronic Computer Div. of Underwood Corp., 35-10 36th Ave., Long Island City 6, N. Y.

Circle **470** on inquiry card.

Doppler Data Translator. New 2-page data sheet illustrates maker's doppler-data translator.—Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

Circle **471** on inquiry card.

Data Reduction Systems. New 4-page brochure describes maker's "Datrac" data-reduction systems.—Epsco, Inc., 588 Commonwealth Ave., Boston, Mass.

Circle **472** on inquiry card.

Analog Computer. New 2-page illustrated bulletin describes maker's desk-model analog computer.—Control Specialists, Inc., 115 E. Arbor Vitae St., Inglewood 1, Calif.

Circle **473** on inquiry card.

Data Reduction Equipment. New 4-page folder describes maker's complete line of data reduction equipment and components.—Benson-Lehner Corp., 11930 Olympic Blvd., Los Angeles, Calif.

Circle **474** on inquiry card.

Binary Resistance Unit. New 4-page booklet describes maker's binary multi-resistor "BMR-105" used for digital-analog conversion or laboratory resistance standards.—Julie Research Labs., 341 E. 149th St., New York 51, N. Y.

Circle **475** on inquiry card.

Computer. New 2-page bulletin describes maker's "SRCX-1" slant range computer.—Julie Research Laboratories, Inc., 341 E. 149th St., Bronx 51, N. Y.

Circle **476** on inquiry card.

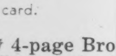
Display C-R Tube. New 4-page Brochure P1-RB-LEC describes maker's "Type 6577 Typotron" character display storage tube.—Huges, Culver City, Los Angeles County, Calif.

Circle **477** on inquiry card.

Matrix Kits. New 2-page bulletin describes maker's "Matrix M16X16-1" plastic encased matrix-kit magnetic storage system.—Valor Electronic Components Co., 5808 Marilyn Ave., Culver City, Calif.

Circle **478** on inquiry card.

TIME, COUNT



Counter-Controllers. New 2-page bulletin describes maker's "Series 5840" magnetic dual-preset controller featuring new Ferristor circuitry.—Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif.

Circle **479** on inquiry card.

Counters & Actuators. New 8-page illustrated brochure describes maker's complete line of electrically operated counters and actuators.—Production Instrument Co., 710-20 W. Jackson Blvd., Chicago 6, Ill.

Circle **480** on inquiry card.

Digit Counters, Computers. New 4-page brochure presents specifications of maker's "Models C-20 & C-30" digit counters for industrial automation and computing industries.—Nemeth, Inc., 2223 C. Carmelina, Los Angeles 64, Calif.

Circle **481** on inquiry card.

Parts Counting Machine. New 2-page data sheet describes maker's "Model B" counting machine which sorts, counts, and divides small objects.—Delta Engineering Corp., 88 Broad St., Boston, Mass.

Circle **482** on inquiry card.

Counters. Two new 2-page bulletins describes maker's "Series 280ERS" automatic cycling predetermining counters and "Series F280ERS" automatic predetermining impulse counters.—Presin Co., 802 N. Fairfax Ave., Los Angeles 46, Calif.

Circle **483** on inquiry card.

Engine Hour Indicators. New 8-page Brochure DC580 presents maker's engine-hour meters for protecting powered equipment.—John W. Hobbs Corp., Springfield, Ill.

Circle **484** on inquiry card.

RECORDING

Oscillography. New 16-page issue of "CEC Recordings" (Vol. 9, No. 6) contains articles on uses of recording oscillographs in testing Ford cars for safety on impact. Other articles are on jet-engine starting, Titrilog health monitor, "Autovac" vacuum gage, etc. —Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Circle **485** on inquiry card.

Electric Typewriter. New 6-page bulletin pictures and describes maker's electric typewriter.—Underwood Corp., One Park Ave., New York, N. Y.

Circle **486** on inquiry card.

Recording Potentiometer. New 8-page Bulletin P1270 describes maker's high-speed electronic "Dynamaster" recording potentiometer for measurement of rapidly changing variables.—Bristol Co., Waterbury 20, Conn.

Circle **487** on inquiry card.

Recording Potentiometer. New 2-page Data Sheet 10.0-21 describes maker's ElectroniK strip chart recorder with full scale pen speed of ¼ sec. —Industrial Div., Minneapolis-Honeywell, Phila. 44, Pa.

Circle **488** on inquiry card.

Recording Camera. New 4-page Bulletin 507 describes maker's automatic camera for recording pictures and pertinent data simultaneously on same frame.—Tailer & Cooper, Inc., 75 Front St., Brooklyn 1, N. Y.

Circle **489** on inquiry card.

Recording Oscillographs. New 4-page folder describes maker's recording oscillographs, amplifiers, bridge balances, velocity transducers, and analog computer.—Wm. Miller Instruments, Inc., 325 N. Halstead Ave., Pasadena 8, Calif.

Circle **490** on inquiry card.

Tape Recorders New 8-page illustrated brochure describes maker's "Series 800" multi-channel magnetic tape recorders.—Ampex Corp., 934 Charter St., Redwood City, Calif.

Circle **491** on inquiry card.

Magnetic Tape. New 4-page booklet "How Magnetic Tape is Made" describes manufacture and quality control of maker's magnetic recording tape.—ORRadio Industries, Inc., 12 Marvyn Rd., Opelika, Ala.

Circle **492** on inquiry card.

COPY EQUIPMENT

Photocopier. New 4-page leaflet describes maker's "Contoura-Constat" portable photocopier.—F. G. Ludwig, Inc., Old Saybrook, Conn.

Circle **493** on inquiry card.

Copying Equipment. New 12-page Brochure X260-25M illustrates and describes maker's complete line of "XeroX" copying equipment for duplicating paperwork.—Haloid Co., Rochester 3, N. Y.

Circle **494** on inquiry card.

TACHOMETERS, SPEED

Tachometers. New 4-page Bulletin 105 describes maker's complete line of stationary tachometers.—Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.

Circle **495** on inquiry card.

Tachometers. New 4-page Bulletin 1048 describes maker's portable, centrifugal, chronometric and vibrating reed types of tachometers.—Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.

Circle **496** on inquiry card.

Tachometers. New 4-page folder describes operation of maker's stationary centrifugal tachometers.—Bouli Instrument Co., 65 Madison Ave., N. Y. C., N. Y.

Circle **497** on inquiry card.

Aircraft-Speed Control. New 8-pag illustrated Bulletin SF-10 describe maker's "SC-12 and SC-24" speed control for single and multi-engine aircraft.—Safe Flight Instrument Corp 4 Water St., White Plains, N. Y.

Circle **498** on inquiry card.

VIBRATION, BALANCING

Vibration Exciters. New 8-page issu "MB Vibration Notebook" (Vol. No. 3) describes maker's line of vibra

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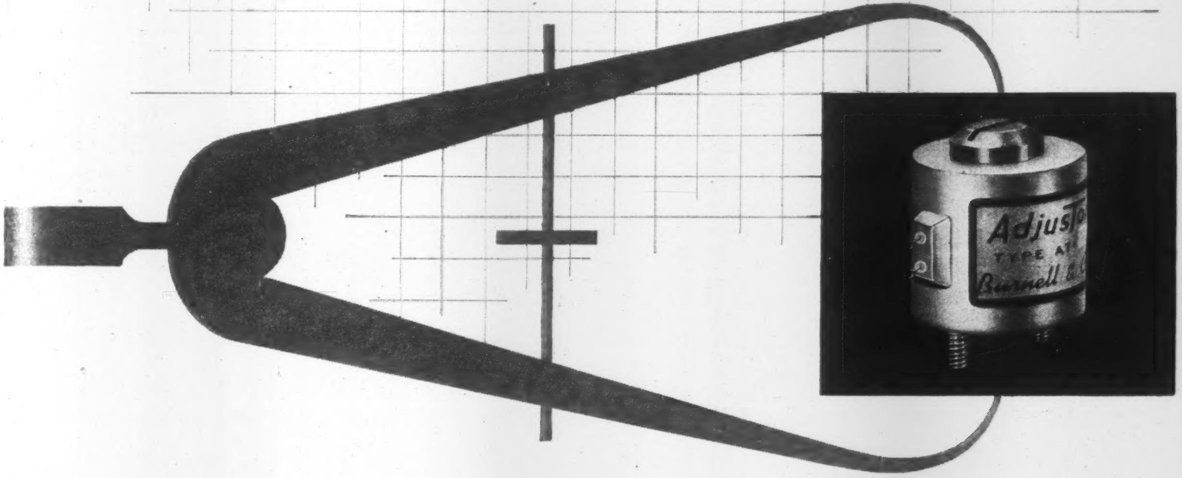

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NEW LITERATURE

tion exciters.—MB Manufacturing Co., 1060 State St., New Haven, Conn.

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Balancing Machine. New 2-page bulletin describes maker's "Type 1250" dynamic balancing machine.—Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio.

Circle **500** on inquiry card.

TESTING, INSPECTION

Ultrasonic Gage. New 4-page Booklet V-101 describes maker's "Vidigage" ultrasonic gage for non-destructive testing, thickness measurements, flaw detection, etc.—Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn.

Circle **501** on inquiry card.

Flaw Detectors. Two new 2-page bulletins describes maker's "Sonometer" a direct transmission, non-destructive flaw detector; and "Echoscope" metal-flaw detector, thickness gage and fluid level indicator.—Curtiss-Wright Corp., P. O. Box 270, Caldwell, N. J.

Circle **502** on inquiry card.

Magnaflux. New 8-page booklet "Lower Manufacturing Costs" describes various uses for nondestructive testing with "Magnaflux."—Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill.

Circle **503** on inquiry card.

Crack Detector. New 4-page leaflet describes maker's "Spotcheck" dye penetrant inspection for finding cracks, seams, porosity, etc. in nonporous materials.—Magnaflux Corp., 7315 W. Ainslie Ave., Chicago 31, Ill.

Circle **504** on inquiry card.

Granular Material Tests. New 2-page Bulletin 233 describes maker's fineness tester for determining fineness of powders and granular materials by air permeability method.—Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Circle **505** on inquiry card.

TEST CHAMBERS

Test Chambers. New 12-page booklet describes maker's environmental test equipment.—International Radiant Corp., 4 Manhasset Ave., Port Washington, N. Y.

Circle **506** on inquiry card.

Humidity Chamber. New 4-page Bulletin 5525 describes maker's "Blue M" relative-humidity chamber.—Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill.

Circle **507** on inquiry card.

Temperature Cabinets. New 4-page brochure describes maker's line of high- and low-temperature cabinets.—Webber Engineering Corp., Dept. B-199, P. O. Box 217, Indianapolis 6, Ind.

Circle **508** on inquiry card.

DIMENSIONAL

Dimensional Gages. New 48-page Catalog 55G pictures and describes maker's dial indicator gages for dimensional control.—Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

Circle **509** on inquiry card.

Dimensional Gages. New 32-page catalog pictures and describes maker's dial, snap and bore gages; setmaster, etc.—Boice Mfg. Co., Inc., Albany Post Rd., Staatsburg, N. Y.

Circle **510** on inquiry card.

Contour Projectors. New 12-page Catalog F2-126 describes maker's "Models 14-2A, 14-5, 30, 8, 3 and 4" contour projectors.—Eastman Kodak Co., 343 State St., Rochester 4, N. Y.

Circle **511** on inquiry card.

ITV

TV Camera Tubes. New 16-page Brochure ETD 1192 describes manufacturing facilities for TV camera tubes.—General Electric Tube Dept., 3800 N. Milwaukee Ave., Chicago, Ill.

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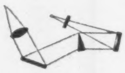
OPTICAL



Cameras, Lens, etc. New 96-page Catalog 1055-L presents maker's complete line of batteries, flash bulbs, aerial cameras, focusing cloth, dynamic viewer, lens flanges, lab cameras, negative preservers, etc.—Burke & James, Inc., 321 S. Wabash Ave., Chicago 4, Ill.

Circle **513** on inquiry card.

Optical Instruments. New 64-page catalog presents list of maker's telescopes and accessories, microscopes, binoculars, lenses, prisms, wedges, etc.—Edmund Scientific Corp., 101 E. Gloucester Pike, Barrington, N. J.

Circle **514** on inquiry card.

Illuminated Magnifier. New 4-page bulletin describes and illustrates maker's "Flash-O-Lens" illuminated magnifier.—E. W. Pike & Co., 492 North Ave., Elizabeth 3, N. J.

Circle **515** on inquiry card.

MAGNETS

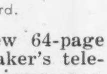
Magnets. New 12-page issue of "Applied Magnetics" (Vol. 3, No. 5) features article on "An Experiment in Magnet Location."—Indiana Steel Products Co., Valparaiso, Ind.

Circle **516** on inquiry card.

Magnetic Laminations. New 20-page Catalog ML 201 "Performance Guaranteed Magnetic Laminations" describes maker's line of laminated cores and dies.—Magnetics, Inc., Butler, Pa.

Circle **517** on inquiry card.

NUCLEAR



Nuclear Instrumentation. New 28-page Bulletin NER-2 describes processes used to produce atomic power and instrumentation for these processes.—Industrial Div., Minneapolis Honeywell, Phila. 44, Pa.

Circle **518** on inquiry card.

Scintillation Counter. New 2-page bulletin presents specifications on maker's "Model SC-102" scintillation counter.—Chatham Electronics, Livingston, N. J.

Circle **519** on inquiry card.

Scintillation Counters. New 2-pag bulletin describes maker's scintillatio counters.—Radiac Co., Inc., 489 Fift Ave., New York 17, N. Y.

Circle **520** on inquiry card.

Scintillation Counter. New 4-pag Brochure 188 describes maker "Model SC-188DA" airborne scintillation counter for geophysical exploration.—Mt. Sopris Instrument Corp 1320 Pearl St., Boulder, Colo.

Circle **521** on inquiry card.

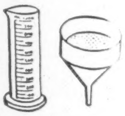
X-Ray Unit. New 6-page leaflet describes and illustrates maker's "Balt graph 200" portable industrial X-Ra Unit.—Balteau Electric Corp., Ne and Meadown Sts., Stamford, Conn.

Circle **522** on inquiry card.

Ore Analyzer. New 4-page Bulleti M-106 describes maker's uraniun thorium analyzer for determinin amount of uranium and thorium i ores.—Tracerlab, Inc., 130 High St Boston 10, Mass.

Circle **523** on inquiry card.

LAB APPARATUS



Polyethylene Plastics Labware. Ne 12-page Catalog D-1055 pictures an describes maker's polyethylene plastics laboratory supplies.—Palo Laboratory Supplies, Inc., 81 Reade St, New York 7, N. Y.

Circle **524** on inquiry card.

Blood Fractionator. New 4-page brochure describes maker's "Cohn" blood fractionator for separation of whole blood into its components.—Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Mass.

Circle **525** on inquiry card.

Lab Apparatus. New 136-page Catalog 6 presents over 700 items of la equipment, instruments, supplies an sectional furniture.—Will Corp., Rochester, N. Y.

Circle **526** on inquiry card.

Photometer. New 24-page Bulleti B-P1000 A describes maker's "100 Series" light scattering photometer —Phoenix Precision Instrument Co 3803-05 N. Fifth St., Philadelphi 40, Pa.

Circle **527** on inquiry card.

Ovens, Baths. New 12-page catalo describes maker's line of consta temperature equipment.—Modern Laboratory Equipment Co., Inc., 1809-1 First Ave., New York 28, N. Y.

Circle **528** on inquiry card.

Extraction Racks. New 2-page Bu letin 551 pictures and describes mal er's "Vari-Heat" extraction racks fo evaporations, distillations, etc.-

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

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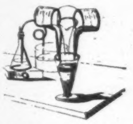
ANALYTICAL



pH and Chlorine Control. New 100-page 12th Edition (1955) "Modern pH and Chlorine Control" pictures and describes comparators, sterilizers, colorimeters, water analyzers, chlorine colorimeters, etc. Includes 45 pages of application data.—W. A. Taylor & Co., 7300 York Rd., Baltimore 4, Md.

Circle **530** on inquiry card.

Flue-gas Analyzer. New 4-page leaflet describes maker's "Model P4" portable flue-gas analyzer.—Thermco Labs., Michigan City, Ind.

Circle **531** on inquiry card.

Oxygen Analyzer. New 4-page Bulletin 108A describes maker's "Model F" oxygen analyzer.—Arnold O. Beckman, Inc., 1020 Mission St., S. Pasadena, Calif.

Circle **532** on inquiry card.

Spectrophotometer. New 12-page Brochure RB2-57-5C describes and illustrates maker's "Model 81" Raman spectrophotometer.—Applied Physics Corp., 362 W. Colorado St., Pasadena, Calif.

Circle **533** on inquiry card.

DU Spectrophotometer. New 10″ x 1[illegible]″ block diagram shows accessories and uses of maker's "DU" spectrophotometer.—Will Corp., Rochester 3, N. Y.

Circle **534** on inquiry card.

Spectrometers, Galvanometers. New 16-page issue of "CEC Recordings" (Vol. 9, No. 5) features article on "Locating Oil with a Mass Spectrometer." And second in technical series on galvanometers.—Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

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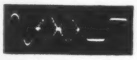
ELECTRICAL, ELECTRONIC INSTRUMENTS



Test Instrument Kits. New 12-page catalog presents 54 of maker's electronic test instruments in kit form.—EICO Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y.

Circle **536** on inquiry card.

Potential Standards. New 2-page Data Sheet 128 describes maker's "K-Volt" Model 310-01 and 310-02" high stability d-c tubeless reference voltage for measurement and control circuits.—Avien, Inc., 58-15 Northern Blvd., Woodside 77, N. Y.

Circle **537** on inquiry card.

Frequency Analyzer. New 2-page bulletin pictures and describes maker's "Model C100A" statistical analyzer system for spectral analysis of signals.—Electronic Control Systems, Inc., 2136 Westwood Blvd., Los Angeles 25, Calif.

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NEW LITERATURE

Hi-Fi Systems. New 100-page Bulletin 151 pictures and describes many lines of amplifiers, boosters, connectors, FM-AM tuners, tape recorders, time switches, etc.—Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Circle **539** on inquiry card.

Charge Neutralizer. New 8-page Bulletin 126 pictures and describes maker's "Magic Wand" electrostatic neutralizer.—Herman H. Sticht Co., Inc., 27 Park Place, New York, N. Y.

Circle **540** on inquiry card.

Servo Amplifiers. New 4-page Brochure TDS-1120-4 describes maker's "Models 1120, 1121, 1123 and 1124 Servoflex" amplifiers.—Servo Corp. of America, New Hyde Park, L. I., N. Y.

Circle **541** on inquiry card.

Electronic Test Equipment. New 8-page Catalog 139 describes and illustrates maker's tube testers, ac-dc multitester, signal generator, geiger counter, etc.—Radio City Products Co., Inc., Centre & Glendale Sts., Easton, Pa.

Circle **542** on inquiry card.

Amplitude Comparison. New 8-page issue of "Experimenter" features article "A New Circuit for Amplitude Comparison."—General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Circle **543** on inquiry card.

High-potential Testing. New 4-page Bulletin 5B describes maker's line of high-voltage test sets.—Associated Research, Inc., 3767 W. Belmont Ave., Chicago 18, Ill.

Circle **544** on inquiry card.

Hi-Fi Amplifiers. Five new 2- and 4-page bulletins present construction information on maker's 8-watt "Stancor-Williamson" amplifier, 25-watt "Stancor-Williamson" ultra-linear amplifier, and 100-watt "Chicago" super-range amplifier.—Chicago Standard Transformer Corp., Addison & Elston Ave., Chicago 18, Ill.

Circle **545** on inquiry card.

Panel Indicators. New 4-page Brochure G-855 pictures and describes maker's D'Arsonal-type panel indicators.—Gar Electrical Instrument Corp., 92-15-172nd St., Jamaica 33, L. I., N. Y.

Circle **546** on inquiry card.

Sound Probe. New 8-page leaflet presents specifications on maker's "Auditec" detector for andis sources.—John Ould (U.S.A.) Ltd., 519 S. Fifth Ave., Mt. Vernon, N. Y.

Circle **547** on inquiry card.

Amplifiers. New 4-page brochure describes and illustrates maker's line of amplifiers, including strain, high-gain a-c, d-c, widehand, etc.—Ilotron Instrument Co., 6516 Detroit Ave., Cleveland 2, Ohio.

Circle **548** on inquiry card.

Millimeter Waves. New 6-page issue of "PRD Reports" (Vol. 4, No. 3) reviews art of detection of millimeter waves.—Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.

Circle **549** on inquiry card.

Power Supplies, Amplifiers. New 4-page leaflet describes maker's magnetic amplifier autopilot, power supplies, integrator, etc.—Hufford Machine Works, Inc., 2201 Camelina Ave., Los Angeles 64, Calif.

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Radar Target. New 4-page Bulletin 6-2-3A describes maker's reflector radar target.—Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.

Circle **551** on inquiry card.

Attenuator Pads. New 2-page Bulletin 17 presents specifications on maker's "Model 210" fixed attenuator pads.—Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md.

Circle **552** on inquiry card.

VISCOSITY

Viscometer. Two new 4-page Bulletins 1124 and 1130 picture and describe maker's Cox "Type II" viscometer for direct indication of kinematic viscosity of Newtonian fluids.—Commercial Research Laboratories, Inc., 20 Bartlett Ave., Detroit 3, Mich.

Circle **553** on inquiry card.

Viscosity Controller. New 2-page Bulletin V-1211 describes maker's automatic viscosity controller.—Norcross Corp., 247 Newtonville Ave., Newton 58, Mass.

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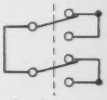

Switches. New 4-page issue of "Micro Tips" (Vol. 1, No. 18) describes many typical applications of Micro switches.—Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.

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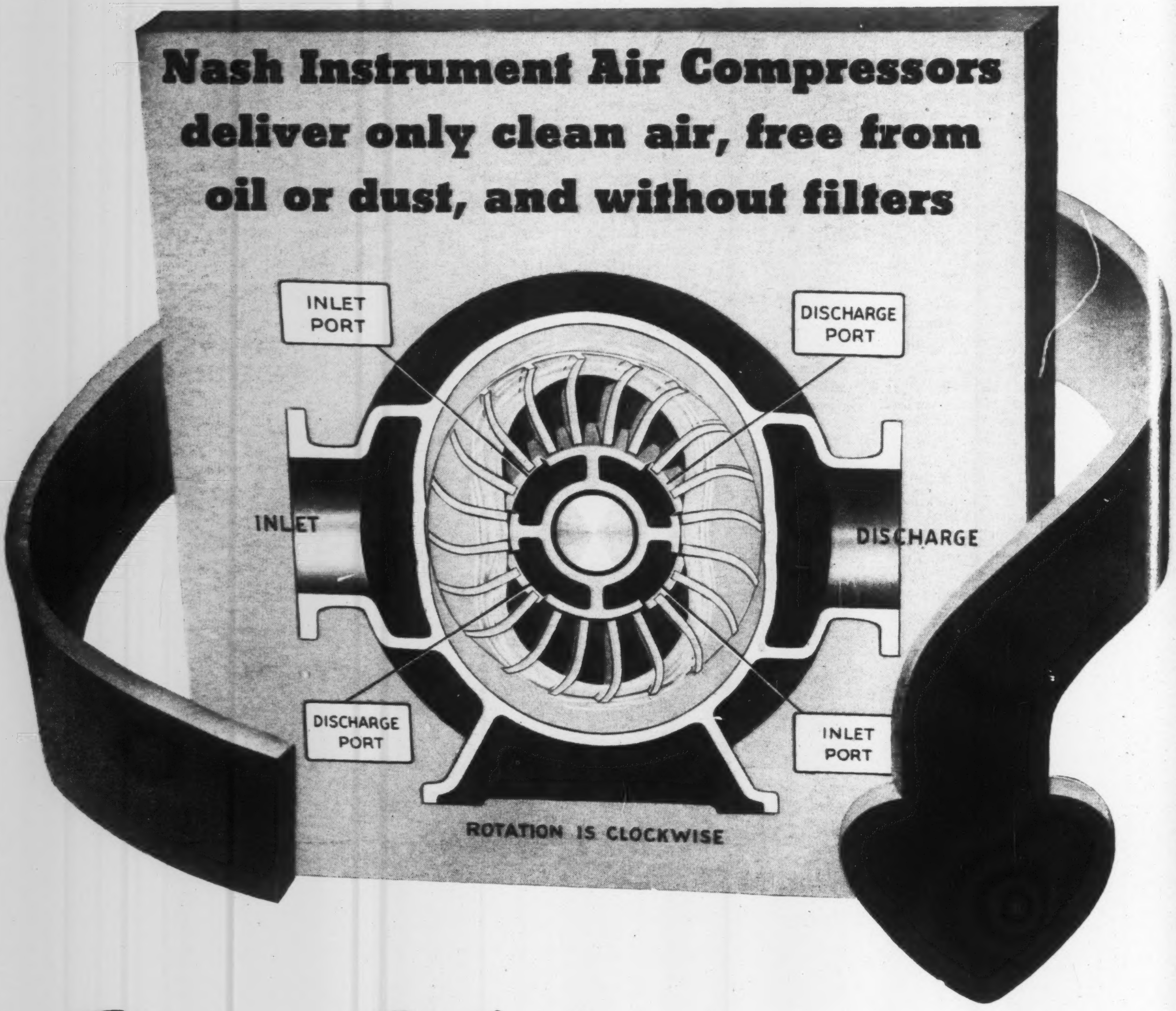
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NEW LITERATURE

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Air Dryers. New 4-page folder describes maker's adsorption-type instrument air dryer.—Anders Lykens Corp., P. O. Box E, Lykens, Pa.
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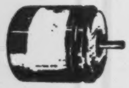
RESISTORS, POTENTIOMETERS



Resistors. New 2-page Bulletin 147 presents specifications of maker's line of wire-wound, vitreous, enameled resistors with axial leads.—Ohmite Mfg. Co., 3680 Howard St., Skokie, Ill.
Circle **569** on inquiry card.

Potentiometer. New 10-page Technical Paper 573 features article on "Precision Potentiometer Life & Reliability".—Helipot Technical Information Service, 916 Meridian, S. Pasadena, Calif.
Circle **570** on inquiry card.

Potentiometer. New 2-page specification sheet presents data on maker's "Model 2007" precision single-turn potentiometer.—William I. Mann Co., Monrovia, Calif.
Circle **571** on inquiry card.

TUBES, TRANSISTORS

Diodes, Transistors. Fifteen new 2-page bulletins present complete data on behavior of maker's transistors and diode parameters with current, voltage, and temperature.—Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Tex.
Circle **572** on inquiry card.

Transistors. New 2-page bulletin presents mechanical and electrical data on maker's "Type 2 N130 PNP" junction transistors used in audio or low radio frequency applications.—Raytheon Mfg. Co., Newton 58, Mass.
Circle **573** on inquiry card.

Transistors. New bulletin describes maker's germanium fused junction NPN transistors "Types HA5001, HA-5002 and HA5003".—Hughes Aircraft Co., Culver City, Calif.
Circle **574** on inquiry card.

Power Tubes. New 8-page Brochure ETI-719B presents list of 282 tube types for which maker has a direct replacement.—General Electric Co., Schenectady 5, N. Y.
Circle **575** on inquiry card.

ELECTRONIC COMPONENTS

Variable Inductors. New 12-page Catalog 9/55 describes maker's Vari-L variable inductors based on control of core permeability.—Vari-L Co., Inc., 432 Fairfield Ave., Stamford, Conn.
Circle **576** on inquiry card.

Transformers, Filters. New 34-page Catalog 56 pictures and describes maker's large line of transformers, reactors, filters, etc.—United Transformer Co., 150 Varick St., New York 13, N. Y.
Circle **577** on inquiry card.

Indicator Lights. New 4-page booklet describes maker's oil-tight indicator lights for heavy-duty industrial applications.—Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y.
Circle **578** on inquiry card.

Connector. New 2-page illustrated Bulletin GA presents electrical and mechanical specifications of maker's 40-contact pressurized 'Continental' connector.—DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.
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MECHANICAL COMPONENTS

Gears. New 24-page Catalog 8 lists maker's complete line of nylon, phenolic and helical gears.—PIC Design Corp., 160 Atlantic Ave., Lynbrook, N. Y., L. I.
Circle **580** on inquiry card.

Instrument Bearings. New 4-page Catalog 551 describes maker's super-precision-ground instrument and miniature bearings.—Microtech Corp., 200 W. Colorado St., Pasadena 1, Calif.
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Ball Bearings. New 8-page bulletin is price list on miniature ball bearings.—Miniature Precision Bearings, Inc., Precision Park, Keene, N. H.
Circle **582** on inquiry card.

Plastic Dials. New 8-page leaflet describes use of maker's precision-fabricated plastics for dials, name plates, schematic diagrams, etc.—Sillcocks-Miller Co., 10 W. Parker Ave., Maplewood, N. J.
Circle **583** on inquiry card.

Screws, Nuts, Rivets. New 64-page semi-annual Catalog covers prices and stock lists of over 9,000 stainless-steel fastenings.—Anti-Corrosive Metal Products Co., Inc., Castleton-on-Hudson, New York, N. Y.
Circle **584** on inquiry card.

Wall Partitions. New 28-page booklet describes maker's "Unistrut" movable wall partitions for factories, warehouses, offices, etc.—Unistrut Products Co., 1013 W. Washington Blvd., Chicago, Ill.
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INSTRUMENTS and AUTOMATION
January '56
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Advertised Products

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New Instruments

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New Literature

401	421	441	461	481	501	521	541	561	581
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404	424	444	464	484	504	524	544	564	584
405	425	445	465	485	505	525	545	565	585
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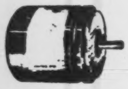
407	427	447	467	487	507	527	547	567	
408	428	448	468	488	508	528	548	568	
409	429	449	469	489	509	529	549	569	
410	430	450	470	490	510	530	550	570	
411	431	451	471	491	511	531	551	571	
412	432	452	472	492	512	532	552	572	
413	433	453	473	493	513	533	553	573	
414	434	454	474	494	514	534	554	574	
415	435	455	475	495	515	535	555	575	
416	436	456	476	496	516	436	556	576	
417	437	457	477	497	517	537	557	577	
418	438	458	478	498	518	538	558	578	
419	439	459	479	499	519	539	559	579	
420	440	460	480	500	520	540	560	580	

Air Dryers. New 4-page folder describes maker's adsorption-type instrument air dryer.—Anders Lykens Corp., P. O. Box E, Lykens, Pa.

Circle **568** on inquiry card.

RESISTORS, POTENTIOMETERS



Resistors. New 2-page Bulletin 147 presents specifications of maker's line of wire-wound, vitreous, enameled resistors with axial leads.—Ohmite Mfg. Co., 3680 Howard St., Skokie, Ill.

Circle **569** on inquiry card.

Potentiometer. New 10-page Technical Paper 573 features article on "Precision Potentiometer Life & Reliability".—Helipot Technical Information Service, 916 Meridian, S. Pasadena, Calif.

Circle **570** on inquiry card.

Potentiometer. New 2-page specification sheet presents data on maker's "Model 2007" precision single-turn potentiometer.—William I. Mann Co., Monrovia, Calif.

Circle **571** on inquiry card.

TUBES, TRANSISTORS

Diodes, Transistors. Fifteen new 2-page bulletins present complete data on behavior of maker's transistors and diode parameters with current, voltage, and temperature.—Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Tex.

Circle **572** on inquiry card.

Transistors. New 2-page bulletin presents mechanical and electrical data on maker's "Type 2 N130 PNP" junction transistors used in audio or low radio frequency applications.—Raytheon Mfg. Co., Newton 58, Mass.

Circle **573** on inquiry card.

Transistors. New bulletin describes maker's germanium fused junction NPN transistors "Types HA5001, HA-5002 and HA5003".—Hughes Aircraft Co., Culver City, Calif.

Circle **574** on inquiry card.

Power Tubes. New 8-page Brochure ETI-719B presents list of 282 tube types for which maker has a direct replacement.—General Electric Co., Schenectady 5, N. Y.

Circle **575** on inquiry card.

ELECTRONIC COMPONENTS

Variable Inductors. New 12-page Catalog 9/55 describes maker's Vari-L variable inductors based on control of core permeability.—Vari-L Co., Inc., 432 Fairfield Ave., Stamford, Conn.

Circle **576** on inquiry card.

Transformers, Filters. New 34-page Catalog 56 pictures and describes maker's large line of transformers, reactors, filters, etc.—United Transformer Co., 150 Varick St., New York 13, N. Y.

Circle **577** on inquiry card.

Indicator Lights. New 4-page booklet describes maker's oil-tight indicator lights for heavy-duty industrial applications.—Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y.

Circle **578** on inquiry card.

Connector. New 2-page illustrated Bulletin GA presents electrical and mechanical specifications of maker's 40-contact pressurized 'Continental" connector.—DeJUR-Amsco Corp., 4[illegible] 01 Northern Blvd., Long Island City 1, N. Y.

Circle **579** on inquiry card.

MECHANICAL COMPONENTS

Gears. New 24-page Catalog 8 lists maker's complete line of nylon, phenolic and helical gears.—PIC Design Corp., 160 Atlantic Ave., Lynbrook, N. Y., L. I.

Circle **580** on inquiry card.

Instrument Bearings. New 4-page Catalog 551 describes maker's super-precision-ground instrument and miniature bearings.—Microtech Corp., 2[illegible]0 W. Colorado St., Pasadena 1, Calif.

Circle **581** on inquiry card.

Ball Bearings. New 8-page bulletin is price list on miniature ball bearings.—Miniature Precision Bearings, Inc., Precision Park, Keene, N. H.

Circle **582** on inquiry card.

Plastic Dials. New 8-page leaflet describes use of maker's precision-fabricated plastics for dials, name plates, schematic diagrams, etc.—Sillcocks-Miller Co., 10 W. Parker Ave., Maplewood, N. J.

Circle **583** on inquiry card.

Screws, Nuts, Rivets. New 64-page semi-annual Catalog covers prices and stock lists of over 9,000 stainless-steel fastenings.—Anti-Corrosive Metal Products Co., Inc., Castleton-on-Hudson, New York, N. Y.

Circle **584** on inquiry card.

Wall Partitions. New 28-page booklet describes maker's "Unistrut" movable wall partitions for factories, warehouses, offices, etc.—Unistrut Products Co., 1013 W. Washington Blvd., Chicago, Ill.

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DEKORON IMPERVAPAK

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Worried about high instrument tubing installation costs? Then Dekoron Impervapak—the chemically resistant instrument tubing harness—is just what the cost analyst ordered.

With Dekoron Metl-Cor or Poly-Cor you don't laboriously install instrument lines one at a time. As many as 19 tubes can be installed at one handling—that's why users report that Metl-Cor cuts costs up to 60%, Poly-Cor up to 80%. Compact construction further reduces racking costs, looks neater and resists mechanical damage.

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JUNCTION BOX

Two types available: for joining lengths of tubing, or for taking off individual lines to instruments *(shown)*. Equipped with synthetic rubber grommets and gasketed cover to make box airtight.

DEKORON IMPERVAPAK METL-COR

Harness composed of 4, 7 or 10 individual copper or aluminum tubes with thick sheath of corrosion-proof polyethylene plastic. In coils of 50 or 100 feet.

DEKORON IMPERVAPAK POLY-COR

Harness made of individual color-coded polyethylene tubes with thick vinyl plastic sheath. Completely corrosion proof. Natural resiliency resists physical damage. In 500-foot coils of 4, 7, 10, 14 or 19 individual lines.

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